Contaminant Monitoring Report For Seafood Harvested In 2002 From The New Bedford Harbor Superfund Site

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U.S. EPA - New England
Mass. Dept. of Marine Fisheries Mass. Dept. of Environmental Protection

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1. Introduction

This report documents the levels of PCBs (polychlorinated biphenlys), cadmium, chromium, copper, and lead measured in four seafood species caught in New Bedford Harbor and surrounding Buzzards Bay in southeastern Massachusetts in 2002. This seafood monitoring program is part of the ongoing PCB cleanup program for the New Bedford Harbor (NBH) Superfund site, and was a collaborative effort involving the MA Department of Marine Fisheries (DMF), the MA Department of Environmental Protection, (DEP) and the U.S. Environmental Protection Agency-New England Region (EPA).

Due to the identification of high PCB levels in area seafood, the MA Department of Public Health in 1979 promulgated regulations restricting seafood consumption in three closure areas in and around NBH (Figure 1). NBH was subsequently listed as a Superfund site in 1983. Approximately 46,000 cubic yards (cy) of the most highly PCB-contaminated subtidal and shoreline sediments have been remediated to date, and the start of the cleanup program's full scale dredging program of roughly 860,000 cy is slated for fall 2004. Consistent with the 1998 Record of Decision (ROD) for the site, this seafood monitoring program will aid in the evaluation of the overall effectiveness of the harbor cleanup, as well as assist in the implementation of institutional controls and seafood restrictions.

2. Seafood Monitoring Program Design

Based on previous investigations and risk assessments performed for the NBH site, four species were selected for this monitoring program that are considered locally caught seafood and which bracket potential worse case tissue levels. These four species are lobster (*Homarus americanus*), winter flounder (*Pleuronectes americanus*), quahog (i.e., hard shelled clam, *Mercenaria mercenaria*) and American eel (*Anquilla rostrata*) The goal of this seafood monitoring program is to acquire annual collections of all species (preferably in pre-spawning condition) in sufficient numbers from all three closure areas to enable statistical comparisons between them.

To meet this goal, the monitoring design calls for five replicate composite samples for each of the four species from each of the three closure areas. Ideally, this would result in a total of sixty samples for analysis of PCBs and metals. For winter flounder, lobster and eel, each composite sample would consist of three legally harvestable organisms and for quahog the composite would consist of one dozen legally harvestable organisms. The number of composites was determined according to Sokal and Rohlf (1995) using the coefficient of variation (c.v.) from the DMF's 1995 lobster sampling program in Area III (mean = 1.3 ppm, standard deviation = 0.28, c.v. = 22%). The significance level used was 5% and the probability that the significance will be found if it exists was set at 90%. Based on the known levels of PCBs in NBH seafood, there is a high likelihood of detecting PCB concentrations that are 50% different between each closure area.

In addition to comparing the results of this monitoring to past and future seafood monitoring results, the results of this seafood monitoring program will be compared to the

current U.S. Food and Drug Administration's (FDA's) criteria for PCBs in commercial seafood of 2 parts per million (ppm). It was exceedances of the FDA criteria in NBH seafood which prompted promulgation of the state's seafood closure areas in 1979 (the FDA criteria at that time was 5 ppm). In addition to comparisons to the current FDA level, and as explained in the 1998 ROD, EPA will compare the results of the seafood monitoring program to a site-specific threshold of 0.02 ppm PCBs. This 0.02 ppm PCB level was developed to ensure the protection of local residents whose seafood consumption might include seafood caught mostly if not entirely from NBH. This 0.02 ppm PCB level was calculated to represent a one-in-one-hundred-thousand chance that an individual would develop cancer as a result of consuming seafood from NBH (10^{-5} incremental cancer risk).

3. 2002 Field Collection

DMF initiated the field sampling program on June 19, 2002 with the collection of quahog from all three seafood closure areas. Quahog collections concluded on September 11, 2002. Five stations were located in each of the three closure areas that produced sufficient sample sizes consistent with the monitoring program design.

Collection of lobster, winter flounder and American eel using fish pots began on October 10, 2002 and concluded on December 13, 2002. Despite considerable effort to collect species according to the monitoring program design, however, all species were not obtained in all three closure areas as originally planned. In summary, lobster were not found in Area I (despite 90 trap hauls) and only a limited number of winter flounder (4) and eel (2) were found in Area I only (despite 72 and 86 trap hauls, respectively). As a result of this limited sample recovery, the 2003 field collection (not covered by this report) was modified to include other locally-consumed seafood species including blue crab, scup, summer flounder and black sea bass.

Complete collection information including the dates fished, identification information, species, station identification, latitude and longitude, collection method and chain of custody is included in Appendix A and B. All samples were delivered frozen to the DEP Wall Experiment Station (WES) in Lawrence, MA on January 3, 2003.

The locations of all seafood collection stations included in the 2002 field effort are shown in Figures 2 through Figure 6.

4. Analytical Chemistry

The first step in the analytical process was the compositing of the quahog and lobster samples. For quahog, twelve individuals from each sample location were combined to form one composite sample per location. For lobster, three individuals from each sample location were used to form composite samples. The tail and claw meat from each of the three animals were combined to form a tail and claw meat composite sample for the location, and the tomalley from each of the three animals was combined to form a separate composite sample for the location.

The tail/claw meat composites were analyzed separately from the tomalley composites in order to quantify the PCB levels in the respective tissue types. A combined PCB level for the tail and claw meat combined with the tomalley was then calculated as follows:

$$\frac{[(\text{tail/claw PCB conc.} \times \text{tail/claw weight}) + (\text{tomalley PCB conc.} \times \text{tomalley weight})]}{(\text{tail/claw weight} + \text{tomalley weight})}$$

The seafood samples were analyzed by WES using modified method 983.21(modified method 8082) for five PCB Aroclors and for 28 specific PCB congeners. Modified method 983.21 is a dual column GC/ECD (gas chromatogram/electron capture detection) method. Both the Aroclor and the congener approach were used to allow comparisons with previous site data of both types. The five Aroclors measured were Aroclors 1232, 1242, 1248, 1254 and 1260. The 28 congeners measured were the eighteen NOAA (National Oceanic and Atmospheric Administration) list congeners and the twelve WHO '98 (1998 World Health Organization) list of dioxin-like congeners. Two congeners, BZ #105 and #108, appear on both lists. The NOAA congener list was used by the MA DMF in its analysis of Area III lobsters from 1988 - 1998, while Aroclors had been used previous to this. The NOAA list typically represents approximately 45% of the total PCB in marine tissue (NOAA, 1993).

The congeners quantitated in this effort were BZ #8, 18, 28, 44, 52, 66, 77*, 81*, 101, 105*, 114*, 118*, 123*, 126*, 128, 138, 153, 156*, 157*, 167*, 169*, 170, 180, 187, 189*, 195, 206, and 209 (* indicates dioxin-like congener). Congeners #170 and #180 were removed from the WHO '96 list and do not appear on the WHO '98 list. The WHO '98 congeners were included to enable the evaluation of risks to human health due to the presence of any dioxin-like PCB congeners, if deemed necessary.

Tissues from lobster meat, lobster tomalley, quahogs, flounder and eel were collected and filleted, sub-sampled and composited for sample extraction and analysis. For each group, 20 grams of wet sample tissue was mixed with anhydrous sodium sulfate (Na_2SO_4) and 200 mL hexane and ground/homogenized using a tissuemizer. The resulting mixture was then filtered through a sharkskin filter utilizing a side arm Buchner funnel flask. The resulting clear fluid extract was transferred to a 250 mL volumetric flask and brought to volume with hexane.

This extract was then cleaned up to remove the lipid portion and separate the PCB analytes from the lipid. For this cleanup, a chromatography column containing approximately 20 grams of Florisil was constructed and initially eluted with hexane. A 25 mL aliquot of the 250 mL hexane extract was pipetted onto the column and the eluted liquid collected. The column was subsequently eluted with sequential elutions of 15% diethyl ether/hexane and 50% diethyl ether/hexane to remove the PCB from the column while trapping the lipid portion of the extract. A separate 10 ml of the 250 ml of extract was pipetted into a tared dish and the hexane evaporated to gravimetrically determine the lipid content.

The Florisil-cleaned extract was concentrated using a Kuderna-Danish apparatus and adjusted to 10 mL with hexane for analysis. The dual column, duel ECD detector, gas chromatograph was calibrated for all the above congeners, chlorinated pesticides and for the eight Aroclor standards. The chromatographic conditions were adjusted to permit the separation and quantitative measurement of all the target PCB Aroclors as well as the congeners listed above. Several of the low concentration dioxin-like congeners co-elute with higher concentration (more prevalent) congeners. PCB congeners BZ #77 co-elutes with BZ # 110, and BZ #126 co-elutes with BZ# 129 on the primary column but both were separated on a second confirmation column. Therefore, PCB congeners BZ# 77 and BZ #126, if present can be quantitated on the confirmation column. Both of these congeners have relatively high dioxin-like characteristics.

The quantitation is performed by identifying the congener or Aroclor using the calibrated retention time windows for each congener or Aroclor and comparing the response of the sample peak to the response of the standard peaks over the calibration range. The WES Standard Operating Procedure #AOAC 983.21 should be consulted for further details on chromatographic conditions, quality control criteria, and other elements of the analysis. While lipid content was reported, the wet weight PCB concentrations reported herein are not lipid normalized.

5. Results and Discussion

As with previous studies of sediments, water column, marine tissue, and air at the NBH site, the current data set demonstrates a decreasing trend (north to south) of PCB levels in marine tissue. In other words, tissue PCB levels decrease proportionally with the distance from the primary source of PCBs to the upper harbor (the Aerovox facility). This trend is also clearly noticeable in the individual (as opposed to area-averaged) results from Area I: the tissue samples taken closest to the upper harbor are the highest in PCBs (e.g., quahog site E1, flounder site B1, and eel site A1). Figures 7 through 14 graphically summarize the current data, and Tables 1 through 4 tabulate the individual sample results.

PCBs are a group of similar organic molecules featuring a "figure-eight" structure of two bonded benzene rings with chlorine atoms attached at up to ten different attachment sites. Theoretically, up to 209 different PCB congeners (or molecular variations) are possible, yet only about 120 of these are found in the natural environment. Furthermore, NOAA has demonstrated that 18 specific congeners are the most pervasive and generally make up the majority of PCB mass in marine tissues. In addition, WHO considers 12 specific dioxin-like congeners to present the greatest risk to human health. As noted above in section 4, two congeners, BZ #105 and BZ #118, are included in both the NOAA and the WHO congener sets.

Throughout their industrial use in the U.S., PCBs were sold under the Aroclor trade name. Aroclors are a mixture of congeners, and different Aroclor types consisting of different congeners and chlorine levels were manufactured (e.g., Aroclor 1242 had 42% chlorine, and Aroclor 1260 had 60% chlorine). For this monitoring effort, both Aroclors and congeners (the 28 congeners of the combined NOAA and WHO subsets) were measured to assist in the comparison

with previous site data, as well as to further understand the similarities and differences of these two analytical approaches.

For lobster PCB measurements (but not the other species tested), the current PCB results indicate that the Aroclor approach under-estimates the true PCB concentration in marine tissue. As a rough rule of thumb - for lobsters - the congener results were approximately two times or more higher than the Aroclor results. Note that this approximation becomes less accurate when comparing very low and very high PCB measurements.

Interestingly, for two of the other three species tested (quahog and winter flounder) the opposite result was indicated. For these species, the Aroclor approach yielded results that were roughly twice as high as the congener approach. Again, this approximation becomes less accurate when comparing more extreme PCB values (e.g., see the eel results: 21.32 ppm congeners; 24.37 ppm Aroclors - Figure 14).

It should be noted that PCB tissue levels generally increase with the fat or lipid content of the tissue being tested. Thus, the PCB results for eel and lobster tomalley (both high in lipids) are significantly higher than the other tissues tested.

Overall, the current PCB data indicate a continuing unacceptable risk to human health due to consumption of seafood caught in and around NBH. Obviously this risk does not apply to seafood caught by the harbor's commercial fishing fleet, as this seafood is caught further offshore than the three PCB closure areas discussed herein.

EPA notes, however, that the PCB results for Area III lobster *with the tomalley tissue removed* indicate that risks to human health from lobster tail and claw meat from Area III have moved into its acceptable range (see Figure 8a). With the tomalley included, however, these Area III lobster remain a cause for concern, especially when using the congener analytical approach (see Figure 8). Figure 9 illustrates the current Area III lobster data in context with historic Area III lobster data (with tomalley included), and shows significantly decreased levels from the highest measured readings from the mid-1980's.

For metals, the most striking result is the high copper levels detected in lobster, and to a lesser extent in the Area I flounder and quahog (see Table 4). High copper levels in lobster have been reported in lobster for other areas in and around New England (Soles, 1995; National Research Council Canada, undated), generally attributable to their specific biochemistry. It should be noted, however, that NBH - especially Area I - contains very high levels of copper in both sediments and the water column (U.S. EPA, 1998, Figures 9 and 12).

Finally, although not part of this particular monitoring effort, Appendix 4 summarizes long term blue mussel (*Mytilus edulis*) PCB bioaccumulation data collected at NBH by EPA's research laboratory in Narragansett, RI. Consistent with the discussion above, these data also demonstrate the decreasing north to south trend in seafood tissue PCB levels. The closer the

animals tested are to the upper harbor (north of US Route 195), the higher their PCB body burdens will be.

6. References

EPA, 1998. Record of Decision for the Upper and Lower Harbor Operable Unit, New Bedford Harbor Superfund Site, New Bedford, Massachusetts. U.S. EPA - Region I New England. September 1998.

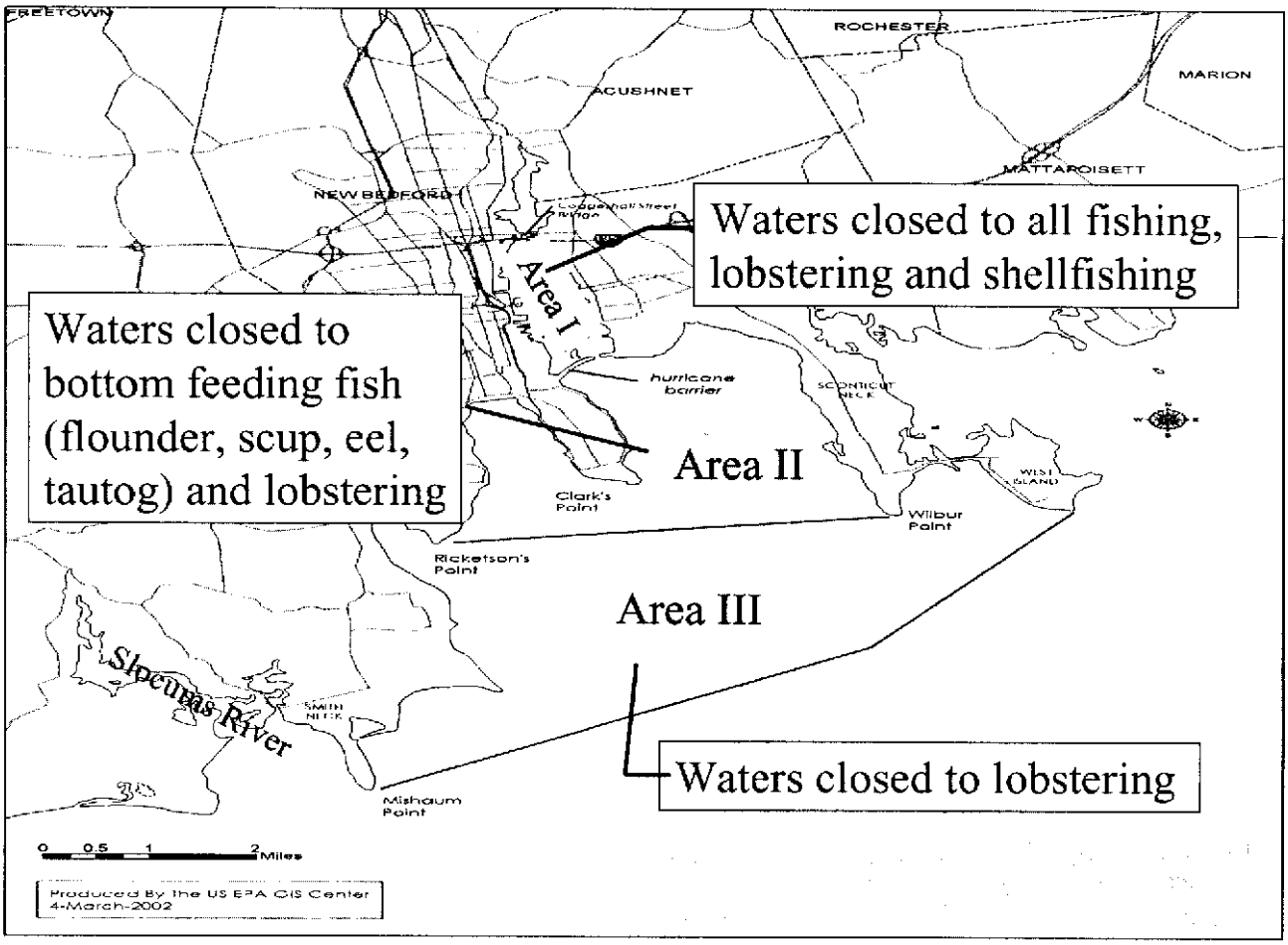
National Research Council Canada, undated. Marine Analytical Chemistry Standards Program, Marine Biological Reference Material for Trace Metals and Other Elements. Tort 1.

NOAA, 1993. NOAA Technical Memorandum NOA ORCA 71. National Status and Trends Program for Marine Environmental Quality. Sampling and Analytical Methods of the National Status and Trends Program National Benthic Surveillance and Mussel Watch Projects, 1984-1992. Volume 1. Silver Springs, Maryland. July 1993

Sokal, R.R., and F.J. Rohlf, 1995. Biometry. 3rd Edition. W.H. Freeman and Co., San Francisco, CA.

Soles, 1995. Surface Water Ambient Monitoring Program, Technical Report. DEPL W-97-1, Maine Department of Environmental Protection.

Figure 1 - the 1979 state fishing ban



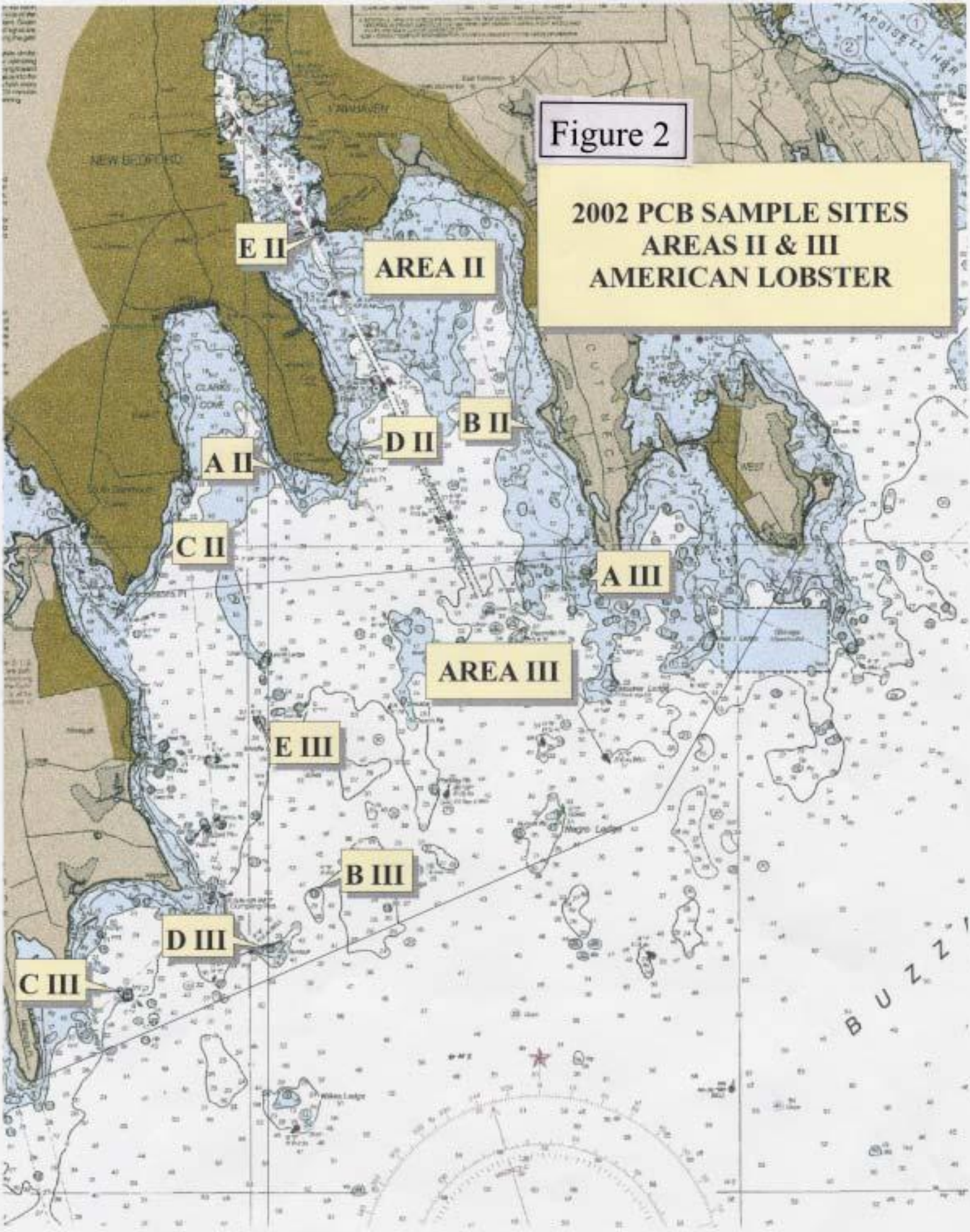
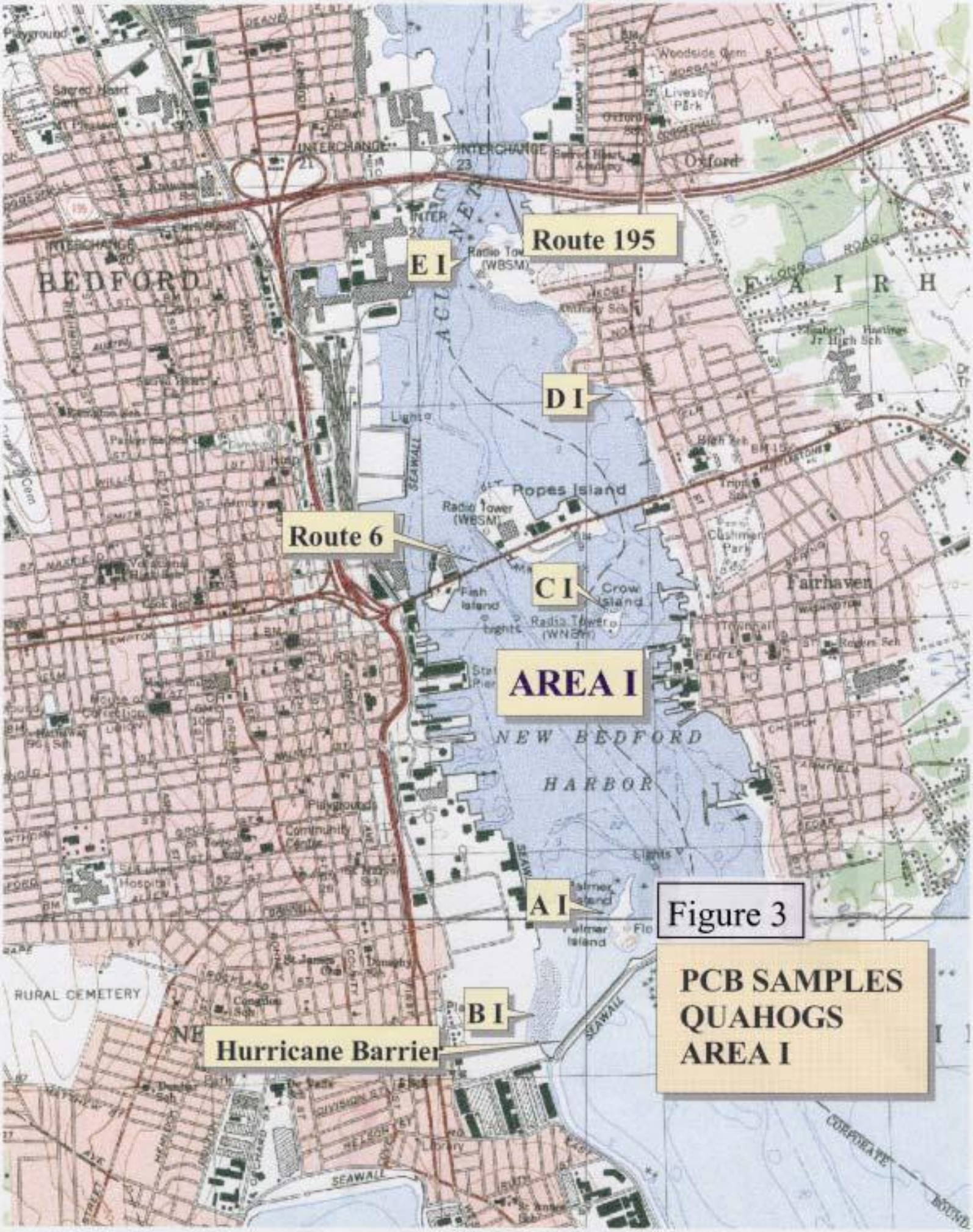


Figure 2
2002 PCB SAMPLE SITES
AREAS II & III
AMERICAN LOBSTER
E II
AREA II
B II
D II
A II
C II
A III
AREA III
E III
B III
D III
C III


Route 195
E I
D I
Route 6
C I
AREA I
A I
B I
Hurricane Barrier
Figure 3
PCB SAMPLES
QUAHOGS
AREA I
BEDFORD
Oxford
Popes Island
Fairhaven
NEW BEDFORD
HARBOR
RURAL CEMETERY
SEAWALL

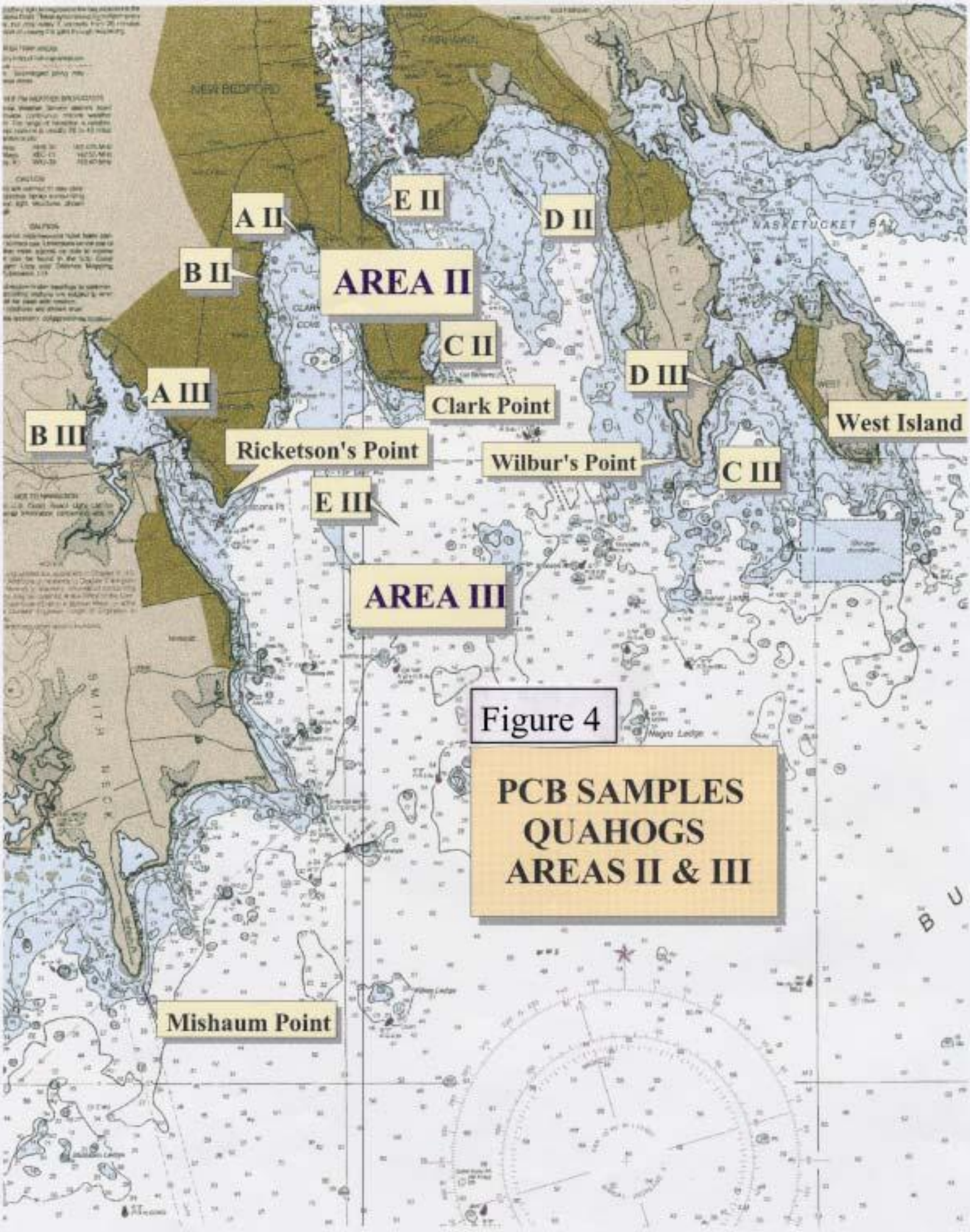


Figure 4

PCB SAMPLES
QUAHOGS
AREAS II & III

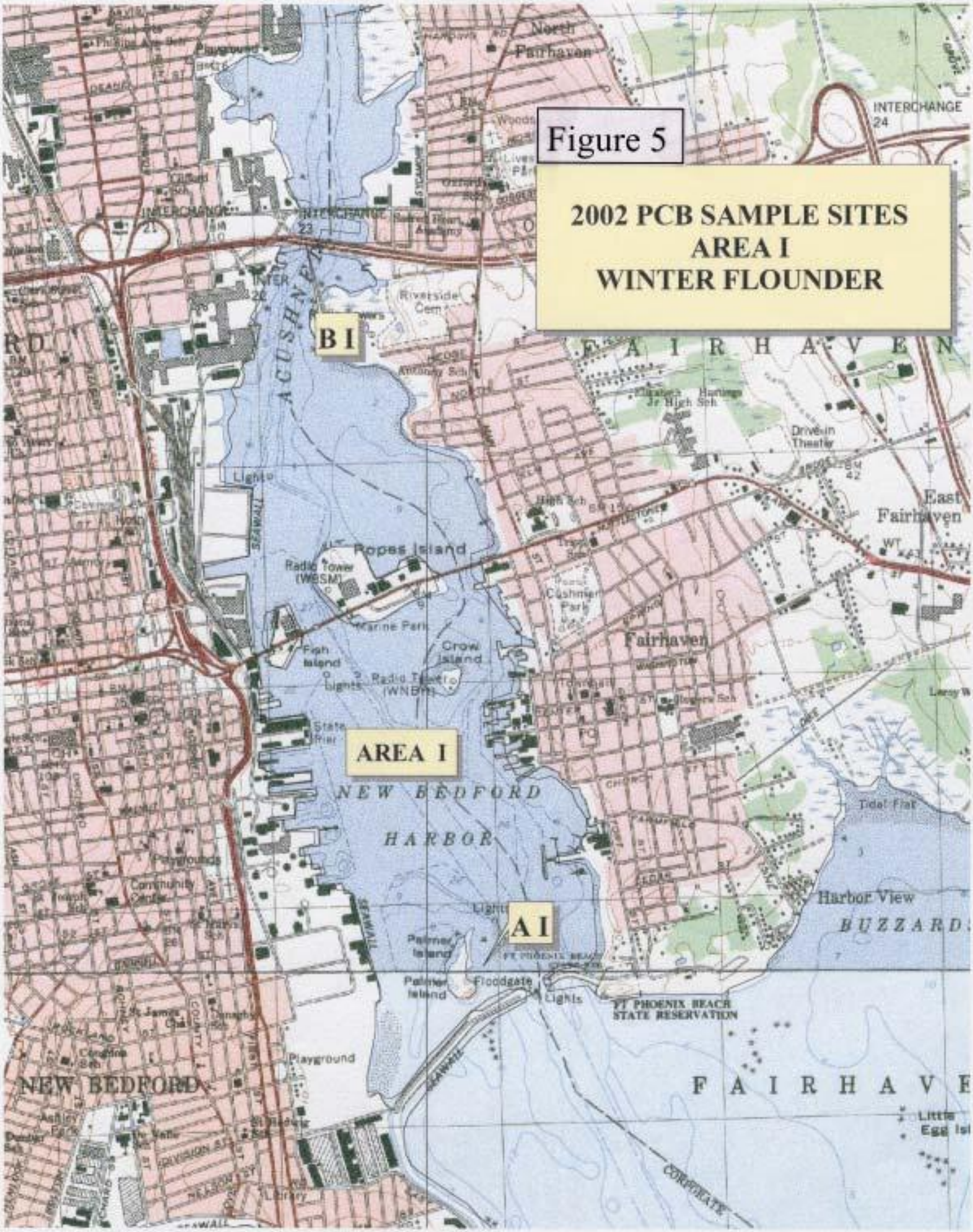


Figure 5
2002 PCB SAMPLE SITES
AREA I
WINTER FLOUNDER
B1
AREA I
A1
ACUSHNET
NEW BEDFORD
HARBOR
Popes Island
Radio Tower (WBSM)
Marine Park
Fish Island
Crow Island
State Pier
Palmer Island
Floodgate
Lights
FT PHOENIX BEACH STATE RESERVATION
FAIRHAVEN
Fairhaven
East Fairhaven
North Fairhaven
Harbor View
BUZZARDS
Tidal Flat
INTERCHANGE 24
INTERCHANGE 23
INTERCHANGE 21
Riverside Cem
Drive-in Theater
Playground
NEW BEDFORD
SEAWALL
Little Egg Isl

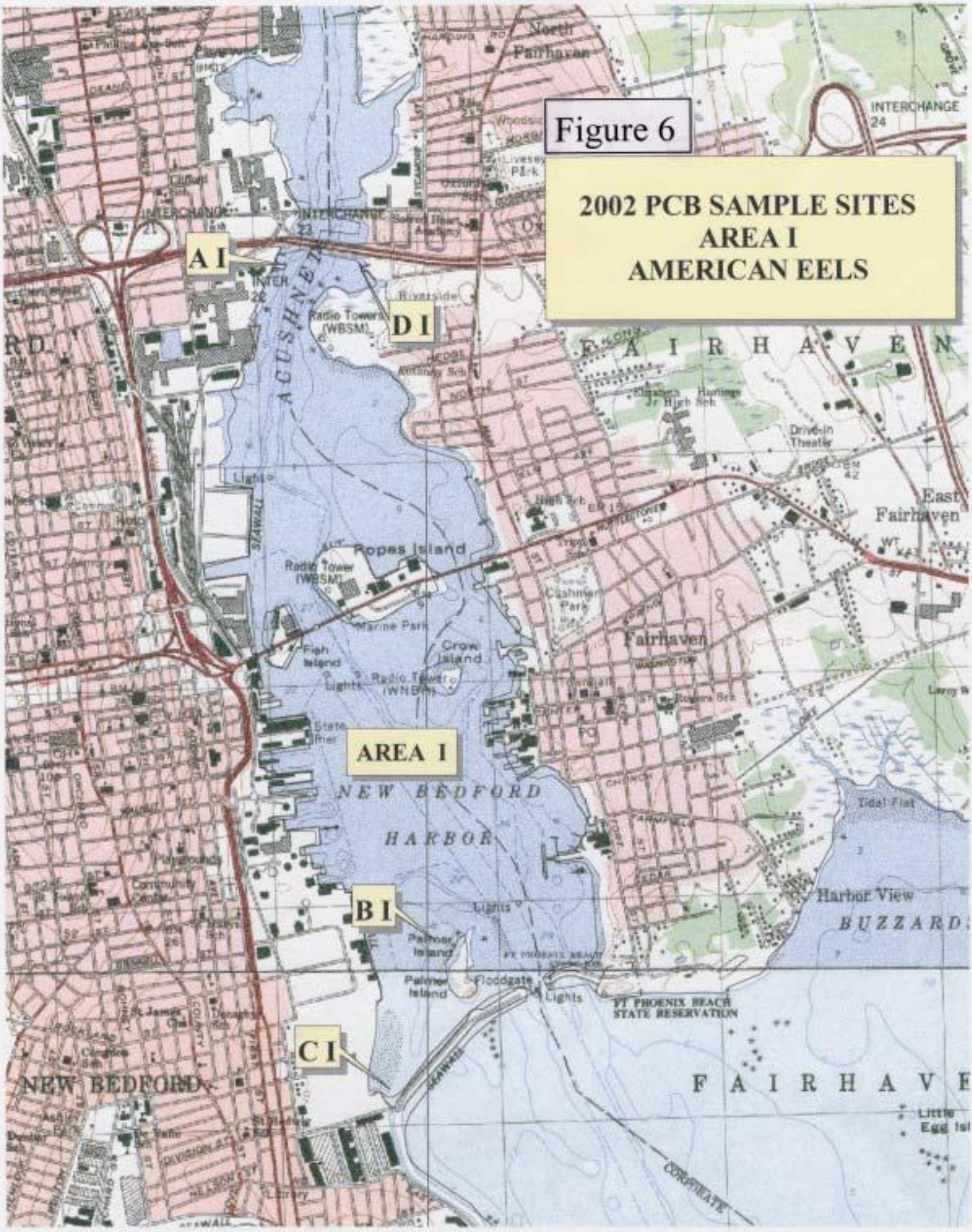
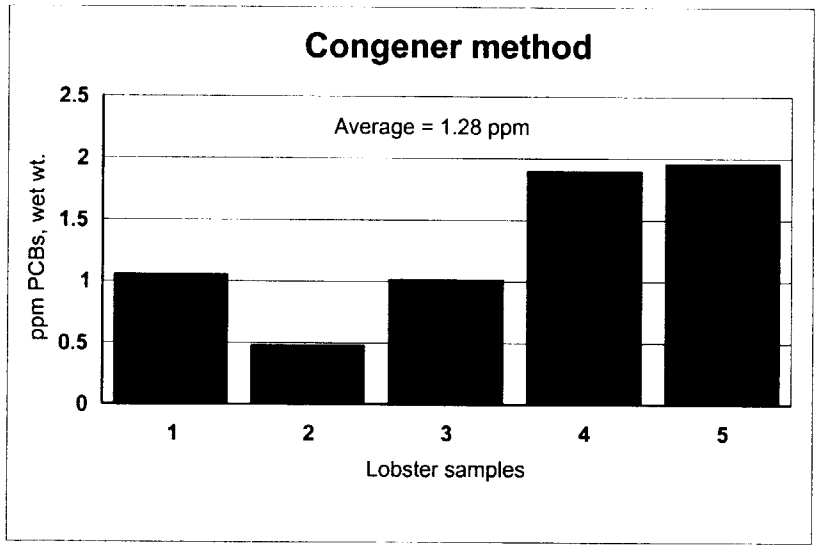


Figure 6
2002 PCB SAMPLE SITES
AREA I
AMERICAN EELS
A I
D I
B I
C I
AREA 1
NEW BEDFORD
HARBOR
Ropes Island
Fish Island
Crow Island
Marine Park
Fairhaven
East Fairhaven
Harbor View
Palmer Island
Floodgate
FT PHOENIX BEACH STATE RESERVATION
NEW BEDFORD
FAIRHAVEN
ACUSHNET
INTERCHANGE 24
INTERCHANGE 23
INTERCHANGE 22
North Fairhaven
Radio Towers (WBSM)
Radio Tower (WNBH)
Tide Flat
Little Egg Isl
CORPORATE

Figure 7: PCBs in Lobster, 2002 - Closure Area II

Tomalley, tail and claw meat



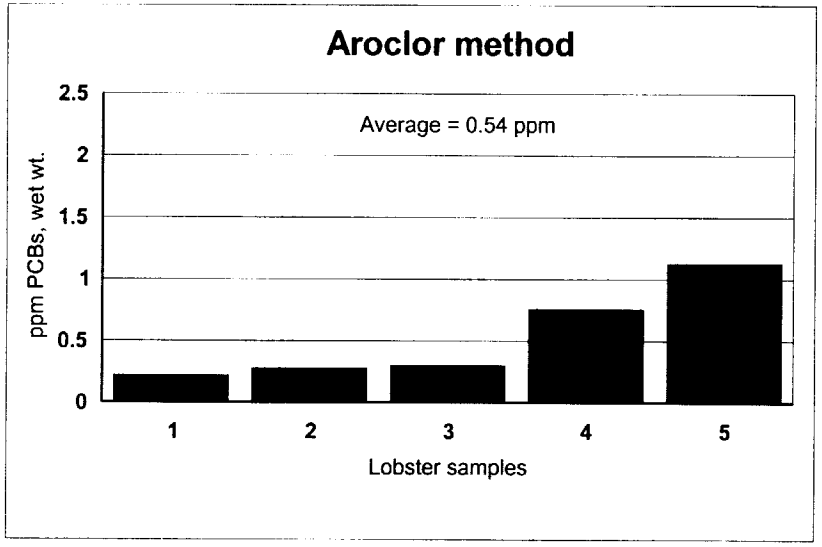
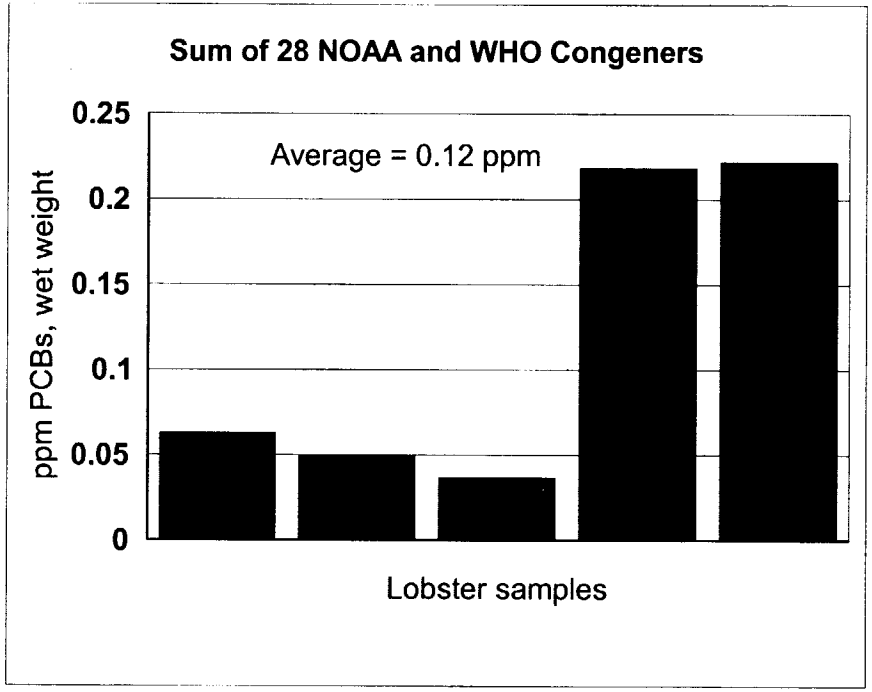
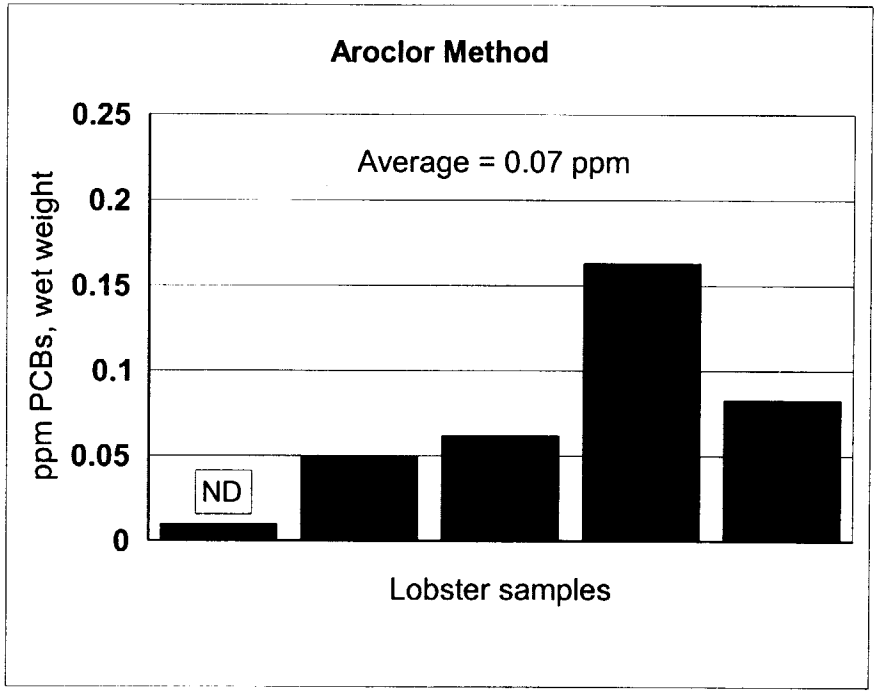


Figure 7a: PCBs in Lobster, 2002 - Closure Area II

Tail and claw meat only - no tomalley

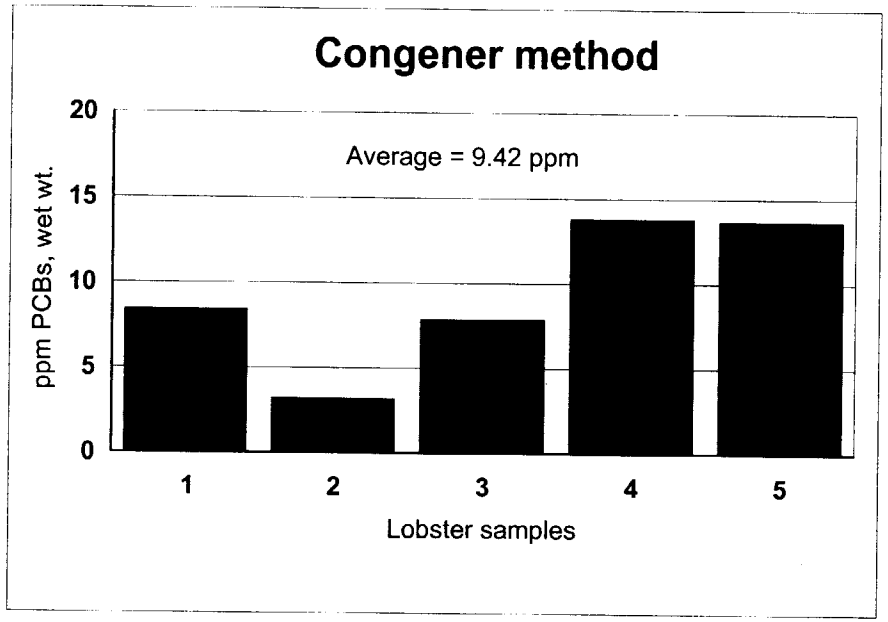




Note: for non-detects (ND), the value shown is the approximate value of the method detection level for each individual Aroclor.

Figure 7b: PCBs in Lobster, 2002 - Closure Area II

Tomalley only



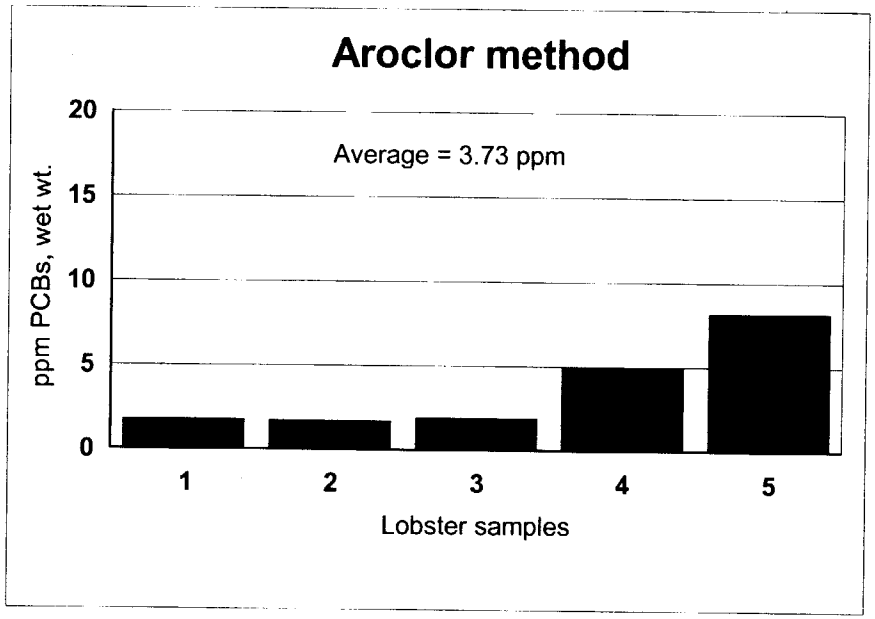
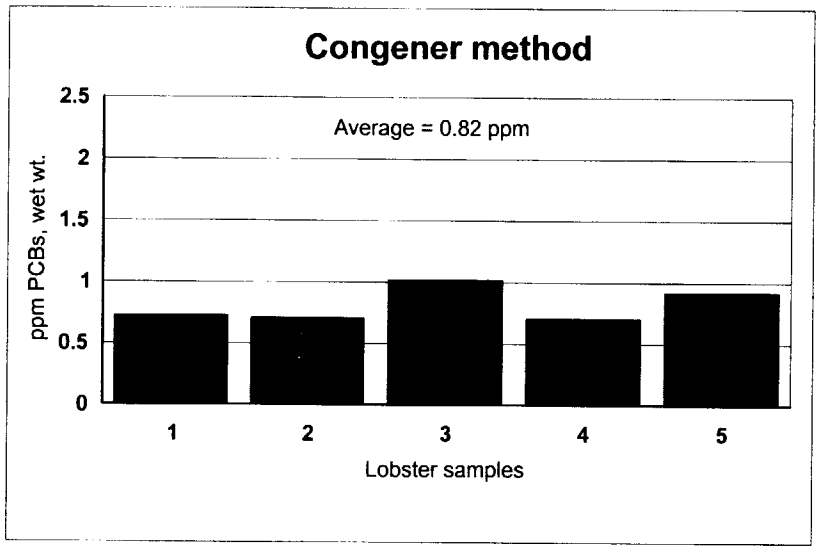


Figure 8: PCBs in Lobster, 2002 - Closure Area III

Tomalley, tail and claw meat



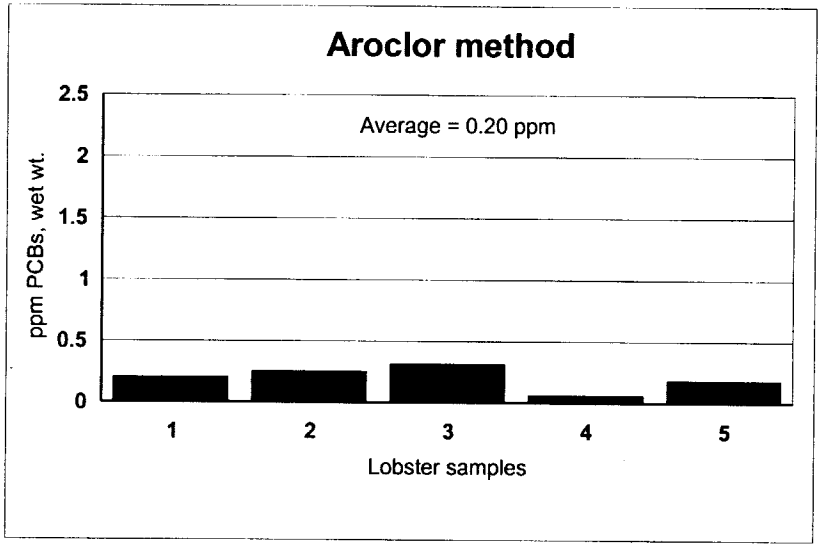
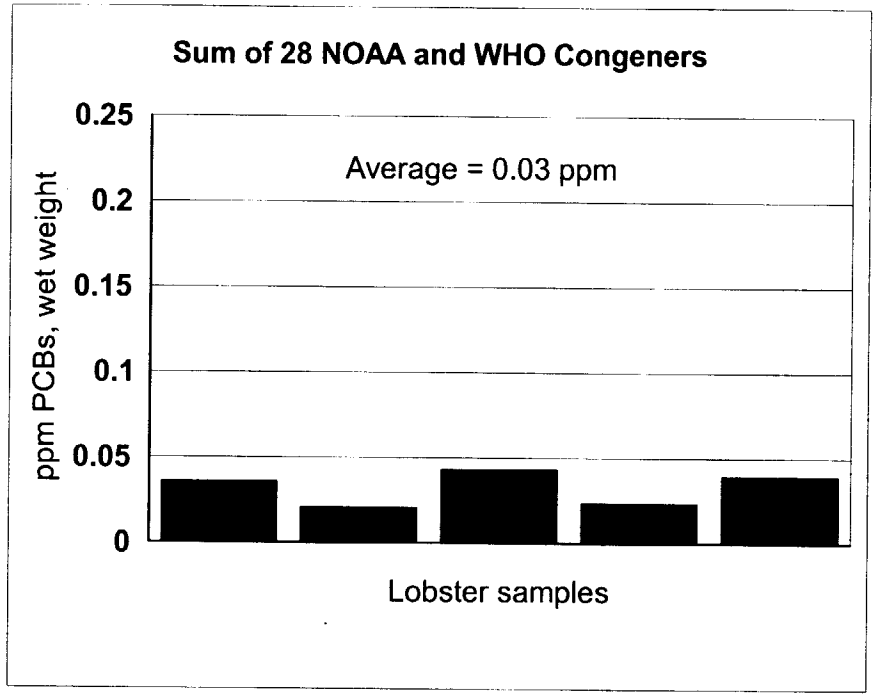
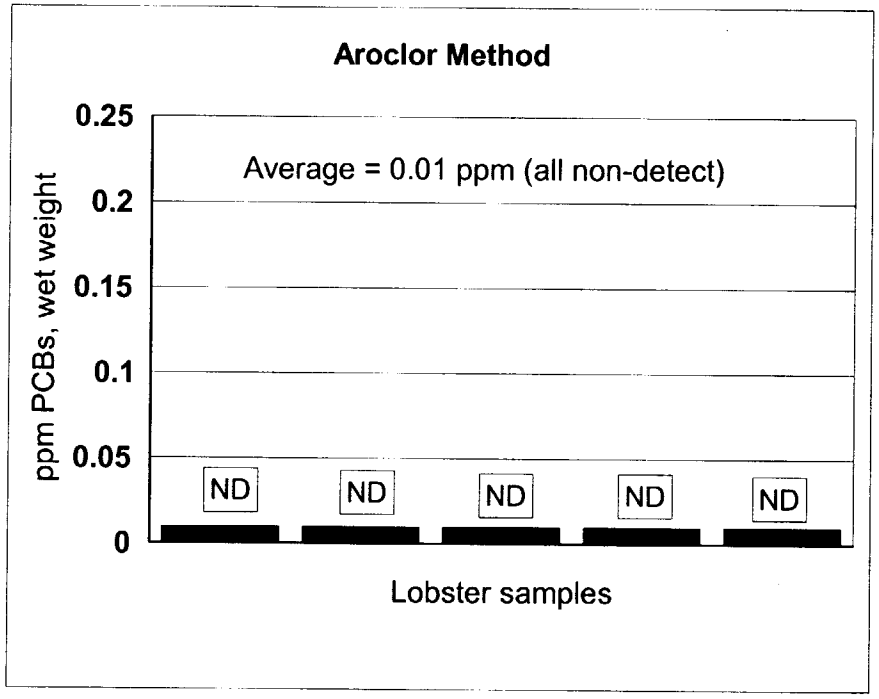


Figure 8a: PCBs in Lobster, 2002 - Closure Area III

Tail and claw meat only - no tomalley

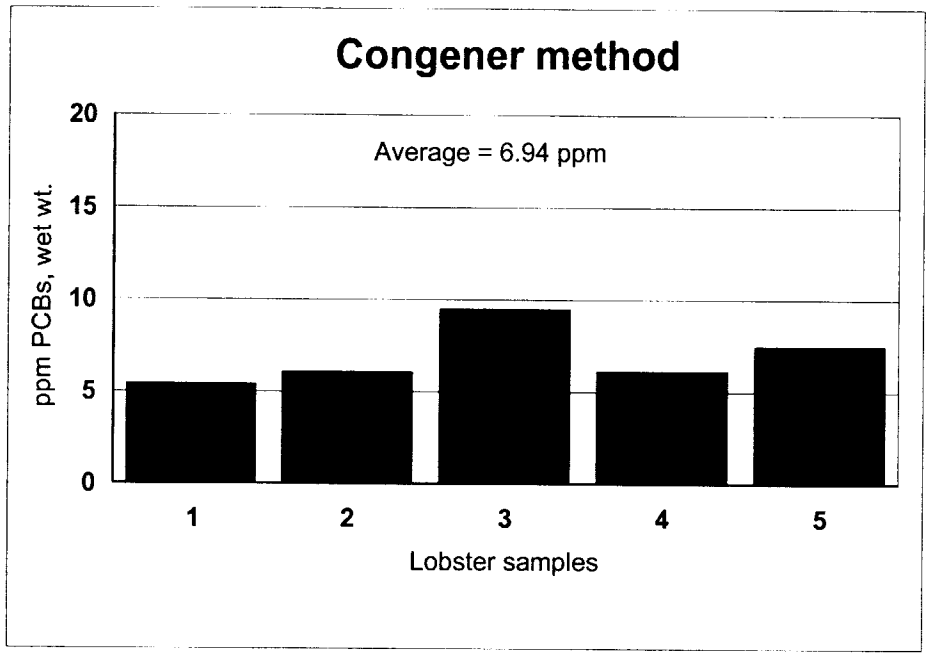




Note: for non-detects (ND), the value shown is the approximate value of the method detection level for each individual Aroclor.

Figure 8b: PCBs in Lobster, 2002 - Closure Area III

Tomalley only



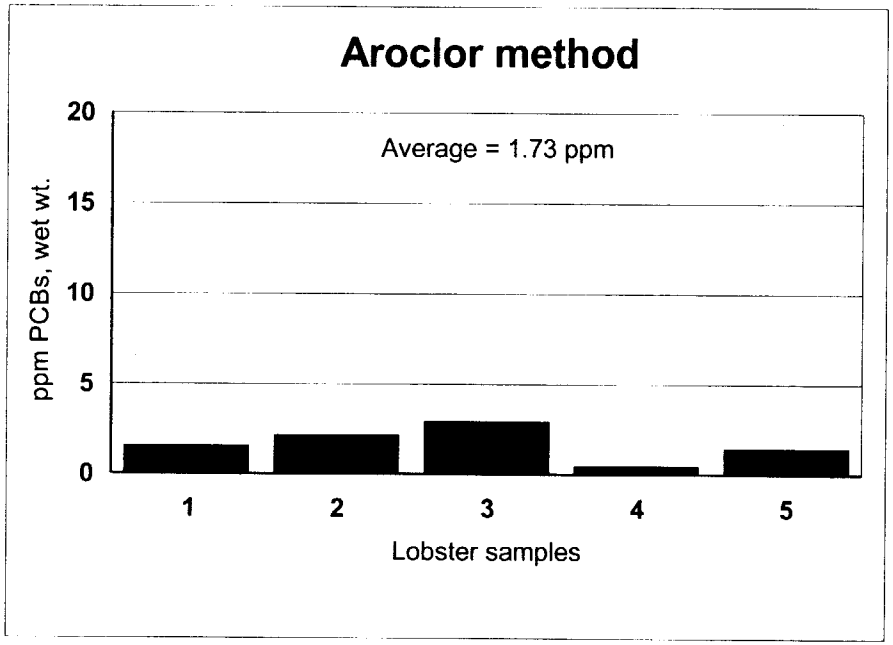
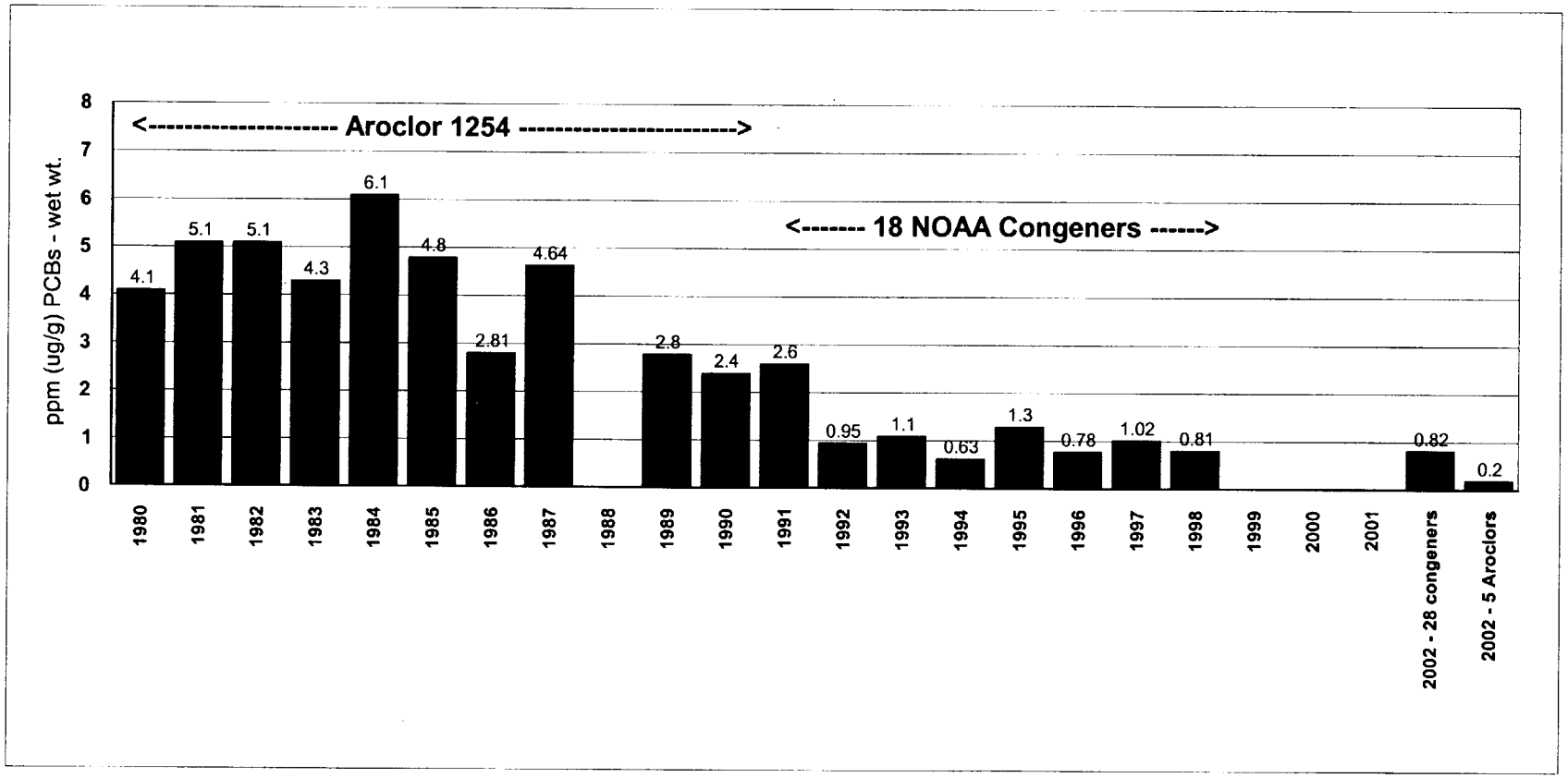


Figure 9 - Spring Season Average PCB Levels in Lobster Since 1980, Area III
New Bedford Harbor Superfund Site

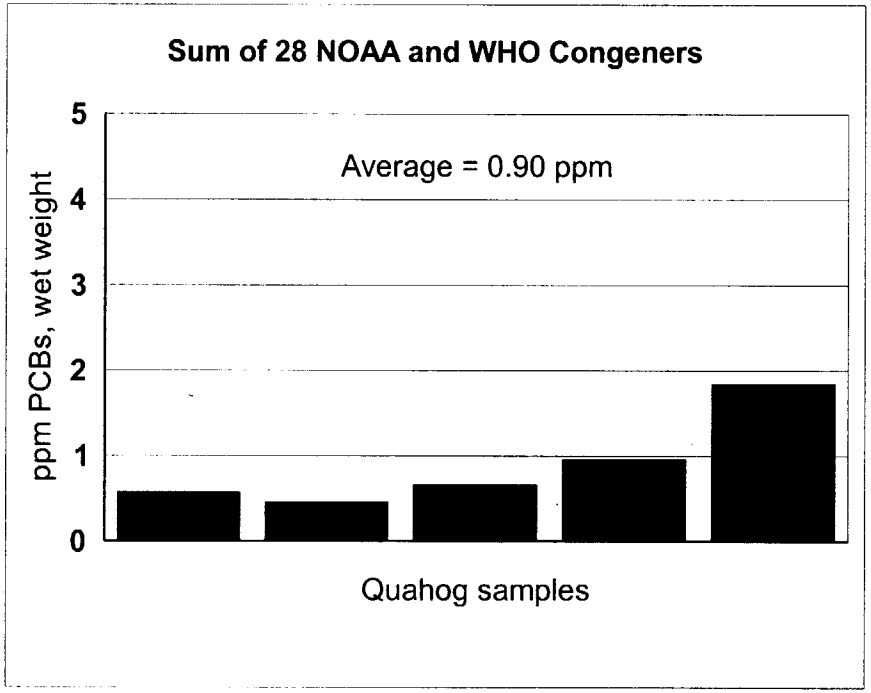
Tail and claw meat with tomalley (see note #4)



Notes:

1. Data from 1980 through 1998 are as reported by the MA DMF. Data for 2002 is from the MA DEP.
2. No data available for 1988, 1999, 2000 and 2001.
3. Data for 1981 is from summer, and data for 2002 is from fall.
4. Tomalley protocol: for DMF data (1990- 1998), the tomalley was physically included with the tail and claw meat prior to analysis. For DEP data (2002), the tomalley was analyzed separately from the tail and claw meat, and a weighted average was performed to calculate a combined concentration.

Figure 10: PCBs in Quahogs, 2002 - Closure Area I



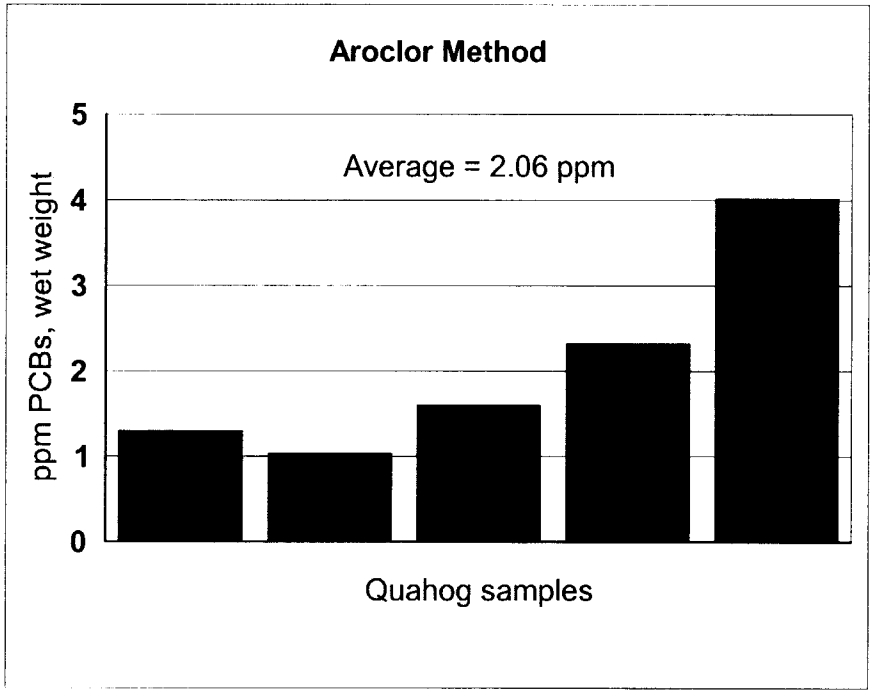
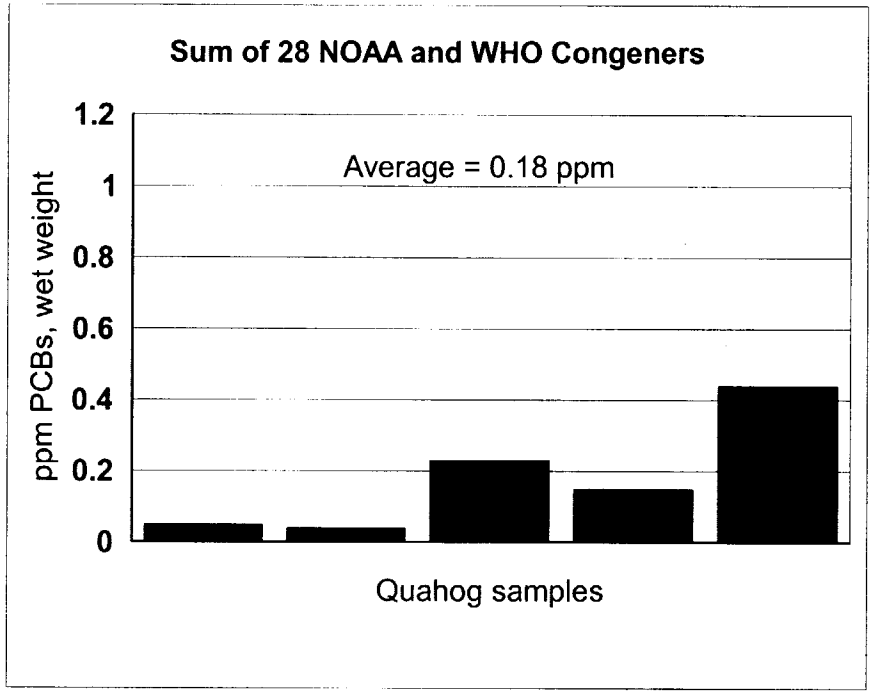


Figure 11 PCBs in Quahogs, 2002 - Closure Area II



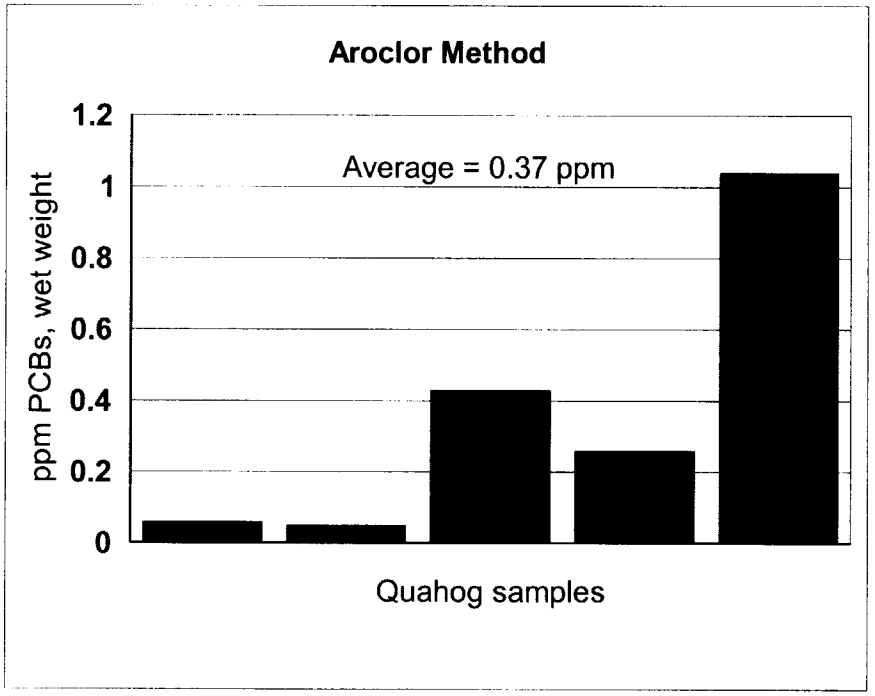
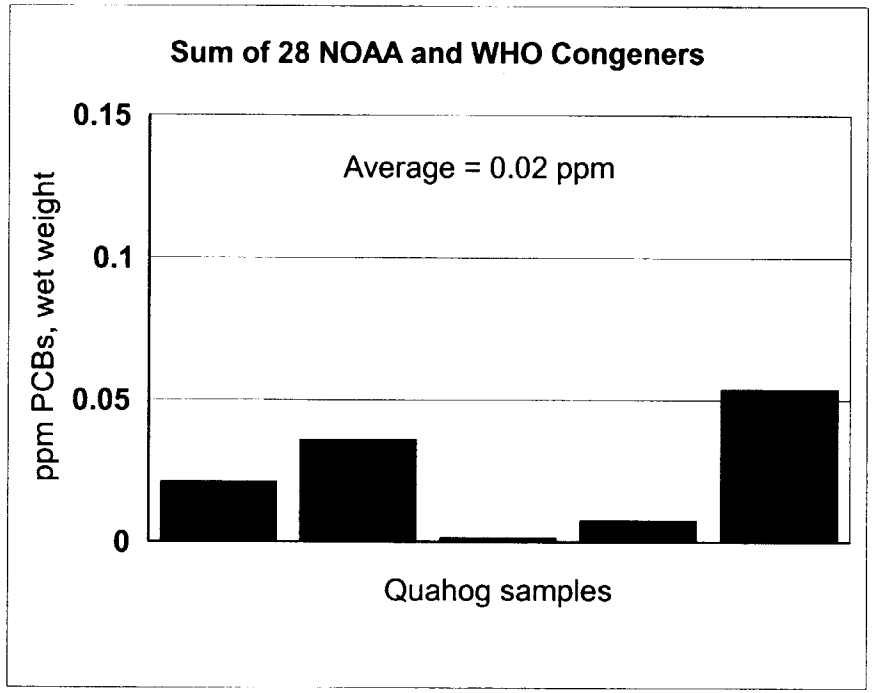
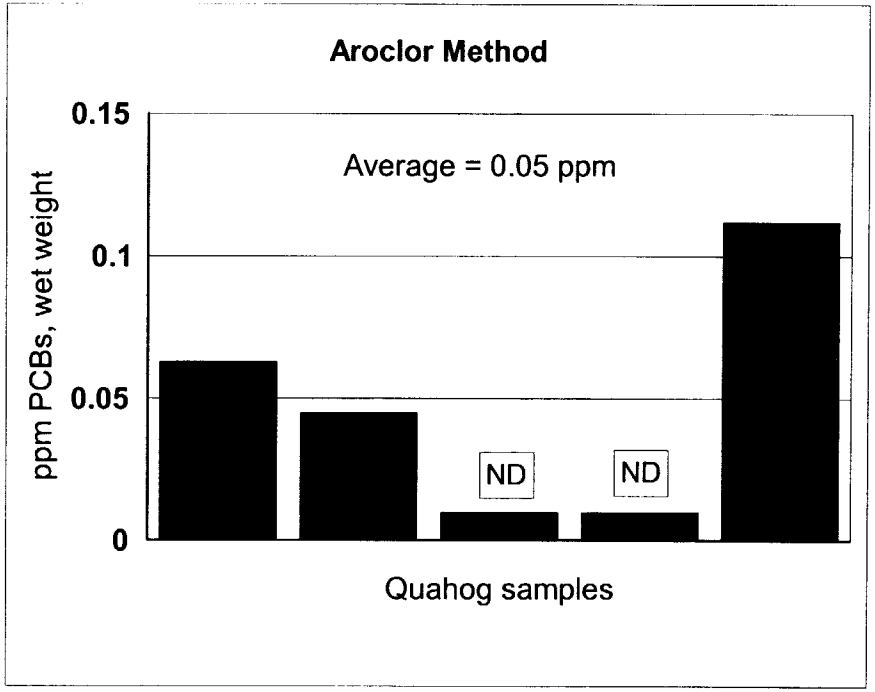


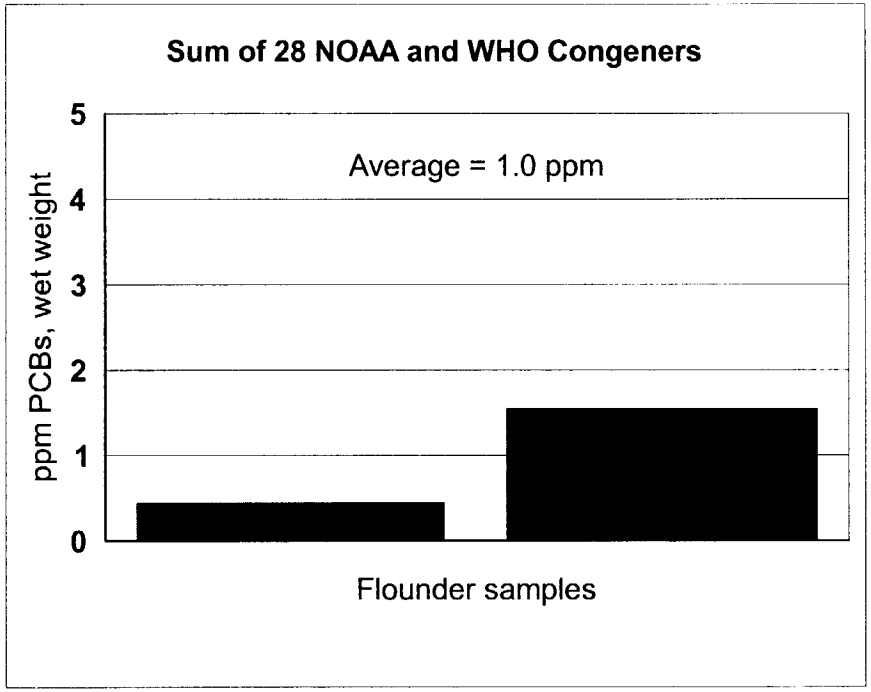
Figure 12: PCBs in Quahogs, 2002 - Closure Area III





Note: for non-detects (ND), the value shown is the approximate value of the method detection level for each individual Aroclor.

Figure 13: PCBs in Flounder, 2002 - Closure Area I



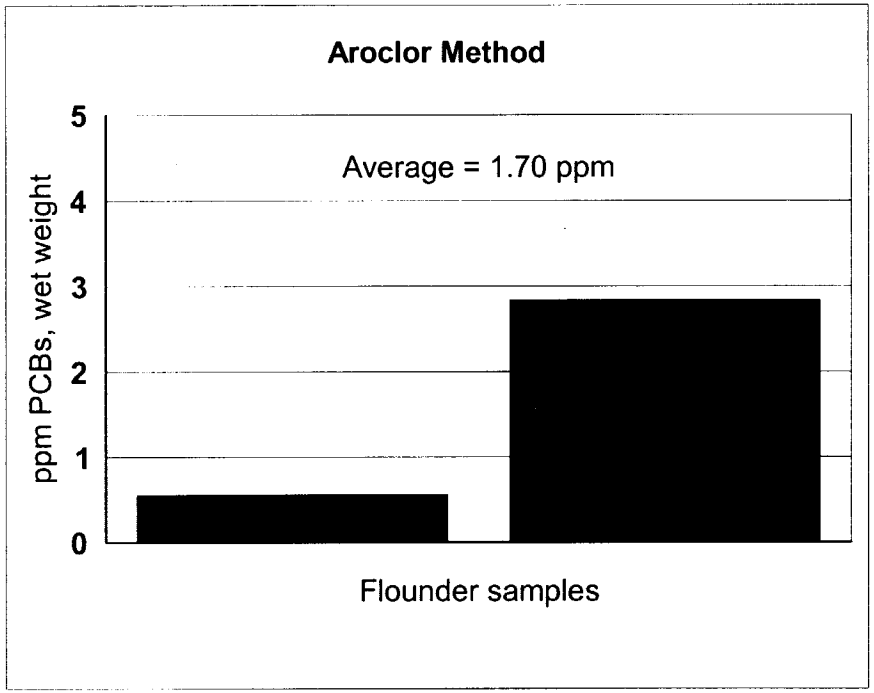
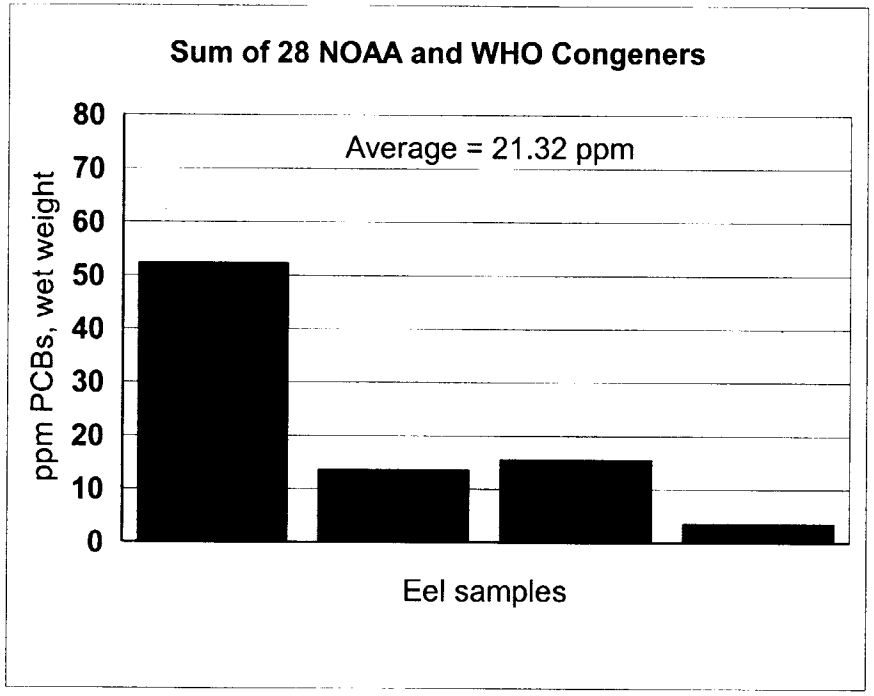


Figure 14: PCBs in Eel, 2002 - Closure Area I



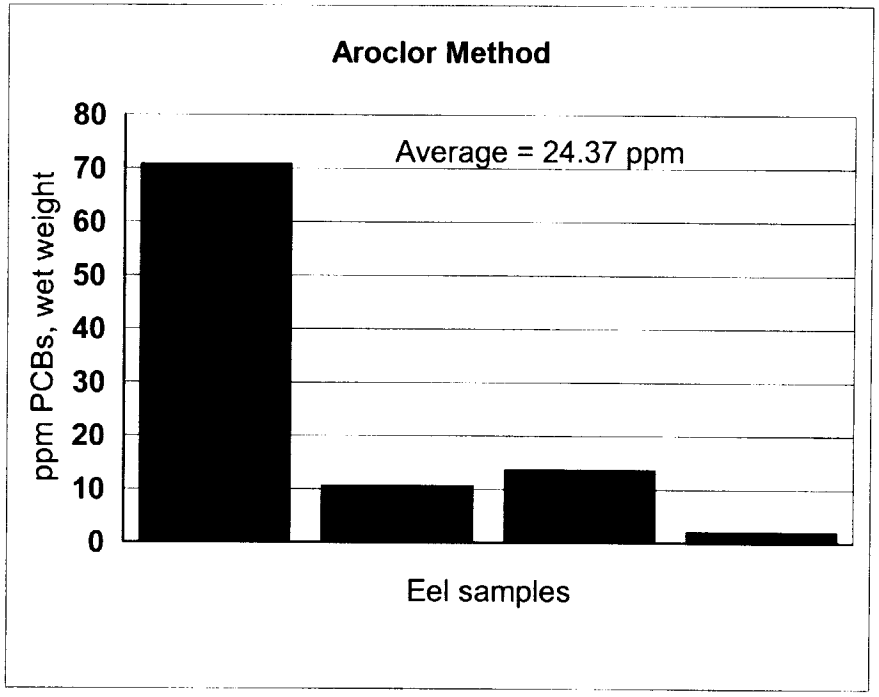
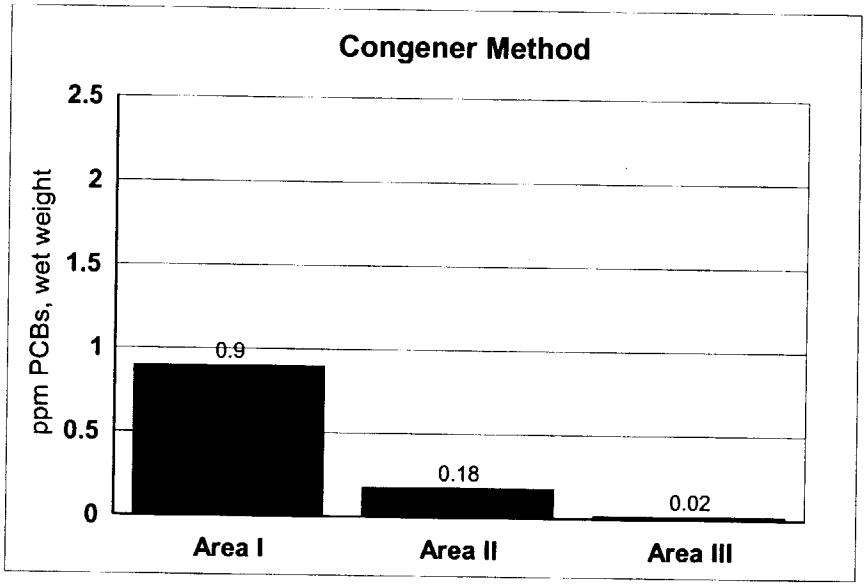


Figure 15: Average PCB Levels in Quahog by Closure Area, 2002



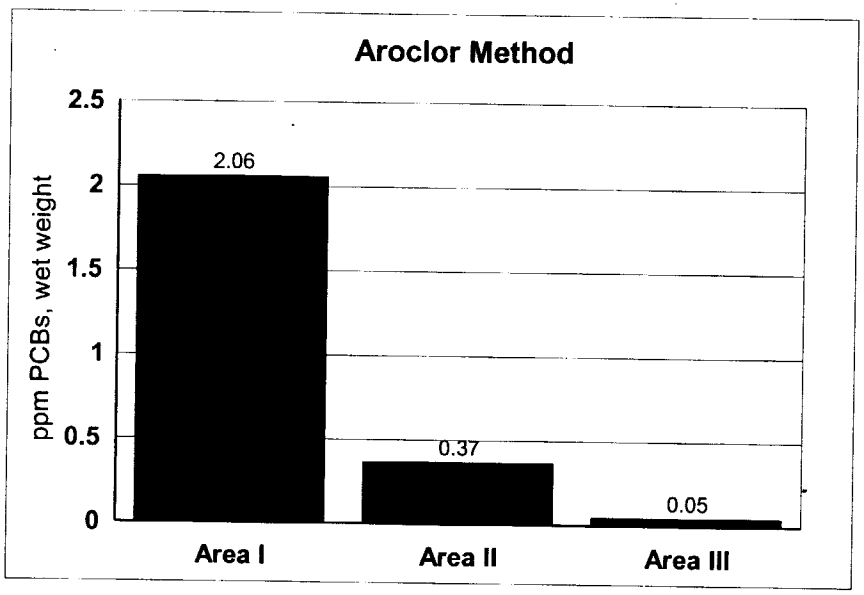
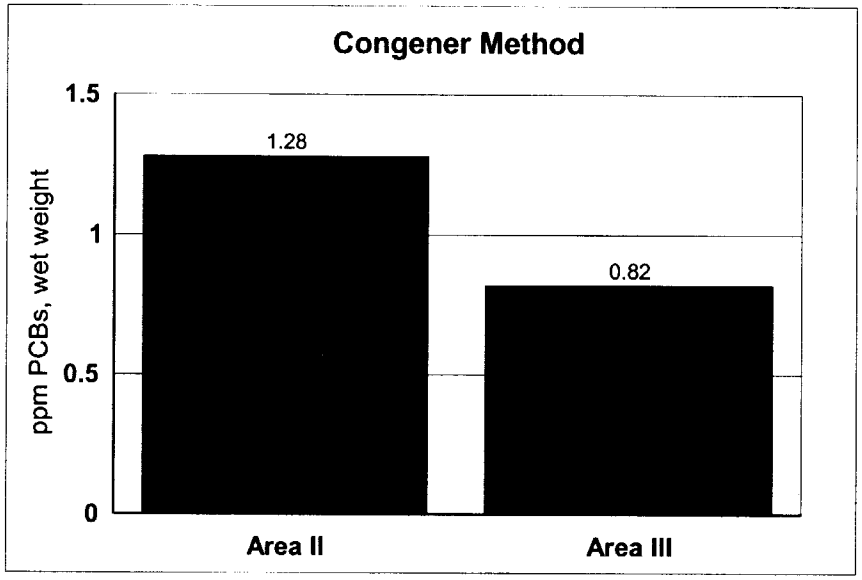


Figure 16: Average PCB Levels in Lobster by Closure Area, 2002

Tail and claw meat with tomalley



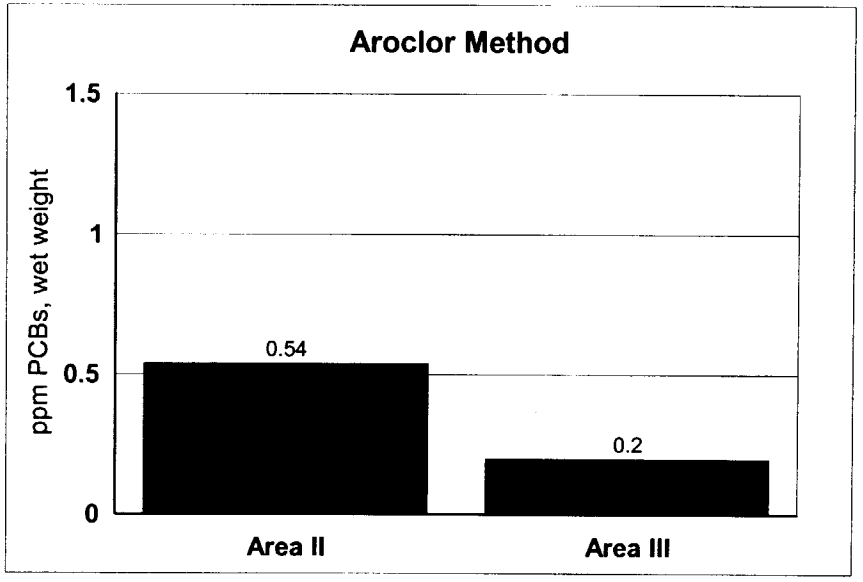


Table 1 - Sample Data for Quahogs, 2002 (ug/g wet weight)

Sample #	Species	Closure Area	Station	Sum of 28 Congeners	Sum of 5 Aroclors	Lipids %	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	BZ.8
2003005-001	Quahog	II	A	0.05	0.06	0.32	ND	0.045	ND	0.016	ND	0.0011
2003005-002	Quahog	II	B	0.04	0.05	0.28	ND	0.046	ND	ND	ND	ND
2003005-003	Quahog	II	C	0.23	0.43	0.57	ND	0.14	ND	0.27	0.023	0.0011
2003005-004	Quahog	II	D	0.15	0.26	0.39	ND	0.12	ND	0.14	ND	ND
2003005-005	Quahog	II	E	0.44	1.04	0.49	ND	0.41	ND	0.59	0.04	0.0062
2003005-006	Quahog	I	A	0.58	1.30	0.63	ND	0.47	ND	0.8	0.031	0.0048
2003005-007	Quahog	I	B	0.46	1.04	0.47	ND	0.4	ND	0.6	0.038	0.0025
2003005-008	Quahog	I	C	0.67	1.60	0.46	ND	0.63	ND	0.91	0.061	0.0054
2003005-009	Quahog	I	D	0.96	2.33	0.62	ND	0.97	ND	1.3	0.058	0.0095
2003005-010	Quahog	I	E	1.85	4.02	0.61	ND	1.7	ND	2.2	0.12	0.3
2003005-011	Quahog	III	A	0.02	0.06	0.41	ND	0.028	ND	0.035	ND	ND
2003005-012	Quahog	III	B	0.04	0.05	0.47	ND	0.031	ND	0.014	ND	ND
2003005-013	Quahog	III	C	0.002	ND	0.33	ND	ND	ND	ND	ND	ND
2003005-014	Quahog	III	D	0.01	ND	0.3	ND	ND	ND	ND	ND	ND
2003005-015	Quahog	III	E	0.05	0.11	0.35	ND	0.036	ND	0.076	ND	ND

ND = not detected

Table 1 - PCB Data for Quahogs, 2002 (ug/g wet weight)

Sample #	BZ.18	BZ.28	BZ.44	BZ.52	BZ.66	BZ.101	BZ.128	BZ.138	BZ.153	BZ.170	BZ.180	BZ.187	BZ.195	BZ.206
2003005-001	0.005	ND	0.0017	0.005	0.0051	0.0075	ND	0.0059	0.0085	ND	0.0015	ND	ND	ND
2003005-002	0.0046	ND	ND	0.0043	0.004	0.0058	ND	0.0047	0.0071	ND	ND	ND	ND	ND
2003005-003	0.016	0.025	0.017	0.036	0.025	0.025	0.0035	0.023	0.023	0.0021	0.0045	0.0041	ND	ND
2003005-004	0.014	0.022	0.016	0.029	0.022	0.013	0.0014	0.0099	0.013	ND	0.0023	0.0025	ND	ND
2003005-005	0.038	0.055	0.026	0.075	0.048	0.059	0.0056	0.037	0.019	0.0032	0.0053	0.0058	ND	ND
2003005-006	0.037	0.082	0.033	0.11	0.052	0.074	0.0056	0.039	0.049	0.0032	0.0047	0.0077	ND	ND
2003005-007	0.036	0.074	0.03	0.083	0.047	0.058	0.0043	0.03	0.034	0.0024	0.005	0.0053	ND	ND
2003005-008	0.052	0.11	0.038	0.12	0.065	0.088	0.0067	0.047	0.025	0.0039	0.0073	0.0064	ND	ND
2003005-009	0.077	0.15	0.053	0.17	0.086	0.13	0.0078	0.063	0.063	0.0049	0.0094	0.0088	ND	ND
2003005-010	0.13	0.35	0.082	0.27	0.061	0.2	0.016	0.091	0.11	0.0078	0.017	0.02	0.0012	ND
2003005-011	0.0063	ND	ND	0.0028	ND	ND	ND	0.0043	0.0042	ND	ND	ND	ND	ND
2003005-012	0.0027	ND	0.0016	0.004	0.0047	0.006	ND	0.0049	0.0064	ND	ND	ND	ND	ND
2003005-013	ND	ND	ND	ND	ND	ND	ND	0.0017	ND	ND	ND	ND	ND	ND
2003005-014	ND	ND	ND	ND	ND	ND	ND	0.0038	0.0039	ND	ND	ND	ND	ND
2003005-015	ND	ND	0.0023	0.0065	0.0059	ND	0.0014	0.0099	0.012	ND	0.0016	0.0025	ND	ND

Table 1 - PCB Data for Quahogs, 2002 (ug/g wet weight)

Sample #	BZ.209	Sum of 16 NOAA Congeners	BZ.77	BZ.81	BZ.105	BZ.114	BZ.118	BZ.123	BZ.126	BZ.156	BZ.157	BZ.167	BZ.169
2003005-001	ND	0.0413	ND	ND	ND	ND	0.0071	ND	ND	ND	ND	ND	ND
2003005-002	ND	0.0305	ND	ND	ND	ND	0.0057	ND	ND	0.0036	ND	ND	ND
2003005-003	ND	0.2053	0.0033	0.0047	ND	ND	0.015	ND	ND	ND	ND	ND	ND
2003005-004	ND	0.1451	ND	ND	ND	ND	0.0086	ND	ND	0.0011	ND	ND	ND
2003005-005	ND	0.3831	ND	ND	0.0043	ND	0.048	ND	ND	0.0053	0.0018	0.0024	ND
2003005-006	ND	0.5020	ND	ND	0.0098	ND	0.06	ND	ND	0.004	0.0015	0.002	ND
2003005-007	ND	0.4115	0.0031	ND	ND	ND	0.041	ND	ND	0.0037	0.0015	0.0018	ND
2003005-008	ND	0.5747	0.0055	ND	0.0043	ND	0.07	ND	0.0015	0.0058	0.0022	0.003	ND
2003005-009	ND	0.8324	0.0071	ND	0.012	ND	0.098	ND	ND	0.0074	0.0023	0.0032	ND
2003005-010	ND	1.6560	0.011	ND	0.011	ND	0.15	ND	ND	0.011	0.0034	0.0077	ND
2003005-011	ND	0.0176	ND	ND	ND	ND	0.0037	ND	ND	ND	ND	ND	ND
2003005-012	ND	0.0303	ND	ND	ND	ND	0.0058	ND	ND	ND	ND	ND	ND
2003005-013	ND	0.0017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2003005-014	ND	0.0077	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2003005-015	ND	0.0421	ND	ND	0.0014	ND	0.0092	ND	ND	0.0012	ND	ND	ND

Table 1 - PCB Data for Quahogs, 2002 (ug/g wet weight)

Sample #	BZ.189	Sum of 12 WHO Congeners	Cadmium	Chromium	Copper	Lead	Solids %	Weight g - wet
2003005-001	ND	0.0071	0.064	0.35	1.75	0.389	11.5	618
2003005-002	ND	0.0093	0.033	0.169	0.734	0.086	10.8	541
2003005-003	ND	0.023	0.141	0.339	2.33	0.189	15.7	506
2003005-004	ND	0.0097	0.065	0.293	1.67	0.201	13	576
2003005-005	ND	0.0618	0.052	0.296	2.16	0.462	13.8	354
2003005-006	ND	0.0773	0.066	0.277	2.95	1.02	15.4	339
2003005-007	ND	0.0511	0.084	0.315	2.86	0.972	14.7	639
2003005-008	ND	0.0923	0.098	0.617	7.1	1.8	14.1	379
2003005-009	ND	0.13	0.071	0.458	3.68	1.37	14.7	274
2003005-010	ND	0.1941	0.112	0.633	4.08	1.37	14.1	313
2003005-011	ND	0.0037	0.054	0.257	2.37	0.83	13.4	417
2003005-012	ND	0.0058	0.084	0.102	1.97	0.377	14.5	435
2003005-013	ND	ND	0.063	0.097	1.7	0.075	10.5	140
2003005-014	ND	ND	0.083	0.061	1.2	0.096	10.5	766
2003005-015	ND	0.0118	0.109	0.383	1.75	0.3	13.1	592

Table 2 - Sample Data for Lobsters, 2002 (ug/g wet weight)

Sample #	Species	Closure Area	Station	Sum of 28 Congeners	Sum of 5 Aroclors	Lipids %	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254
2003006-001	Lobster Meat	III	A-Angelica Rock	0.04	ND	0.26	ND	ND	ND	ND
2003006-002	Lobster Tomalley	III	A-Angelica Rock	5.45	1.56	17	ND	0.59	ND	0.36
2003006-003	Lobster Meat	III	B-Radome R8	0.02	ND	0.19	ND	ND	ND	ND
2003006-004	Lobster Tomalley	III	B-Radome R8	6.10	2.17	25	ND	0.42	ND	0.55
2003006-005	Lobster Meat	III	C-SP Rock C 1	0.04	ND	0.21	ND	ND	ND	ND
2003006-006	Lobster Tomalley	III	C-SP Rock C 1	9.51	2.95	16	ND	ND	ND	0.85
2003006-007	Lobster Meat	III	D-Sand Spit R 4	0.02	ND	0.23	ND	ND	ND	ND
2003006-008	Lobster Tomalley	III	D-Sand Spit R 4	6.15	0.48	28	ND	ND	ND	ND
2003006-009	Lobster Meat	III	Station E Lone Rock N 4	0.04	ND	0.27	ND	ND	ND	ND
2003006-010	Lobster Tomalley	III	Station E Lone Rock N 4	7.51	1.47	21	ND	ND	ND	0.37
2003006-011	Lobster Meat	II	Station A SMAST Pier	0.06	ND	0.28	ND	ND	ND	ND
2003006-012	Lobster Tomalley	II	Station A SMAST Pier	8.44	1.79	18	ND	ND	ND	0.69
2003006-013	Lobster Meat	II	Station B Sconticut Neck	0.05	0.05	0.3	ND	0.05	ND	ND
2003006-014	Lobster Tomalley	II	Station B Sconticut Neck	3.22	1.72	16	ND	0.54	ND	0.58
2003006-015	Lobster Meat	II	Station C Ricketsons Pt	0.04	0.06	0.21	ND	0.062	ND	ND
2003006-016	Lobster Tomalley	II	Station C Ricketsons Pt	7.90	1.92	25	ND	ND	ND	0.82
2003006-017	Lobster Meat	II	Station D E Fort Rodman	0.22	0.16	0.23	ND	0.14	ND	ND
2003006-018	Lobster Tomalley	II	Station D E Fort Rodman	13.82	5.00	15	ND	1.1	ND	2
2003006-019	Lobster Meat	II	Station E Fort Phoenix	0.22	0.08	0.33	ND	0.061	ND	ND
2003006-020	Lobster Tomalley	II	Station E Fort Phoenix	13.70	8.20	12	ND	1.7	ND	4.9

ND = not detected

Table 2 - Sample Data for Lobsters, 2002 (ug/g wet weight)

Sample #	Aroclor 1260	BZ.8	BZ.18	BZ.28	BZ.44	BZ.52	BZ.66	BZ.101	BZ.128	BZ.138	BZ.153	BZ.170	BZ.180
2003006-001	ND	ND	ND	ND	ND	ND	0.0044	ND	0.0018	0.0075	0.014	ND	0.0013
2003006-002	0.61	ND	0.035	0.16	ND	0.039	0.26	0.17	0.13	1	1.6	0.082	0.13
2003006-003	ND	ND	0.0021	ND	ND	ND	ND	ND	ND	0.0044	0.0082	ND	ND
2003006-004	1.2	ND	0.024	0.083	ND	ND	0.19	ND	0.22	1.3	1.9	0.1	0.24
2003006-005	ND	ND	ND	ND	ND	ND	ND	ND	0.0025	0.0074	0.017	ND	0.0025
2003006-006	2.1	ND	ND	0.17	ND	ND	0.24	0.21	0.37	1.4	3.1	0.23	0.48
2003006-007	ND	ND	ND	ND	ND	ND	ND	ND	0.0012	0.0058	0.0099	ND	ND
2003006-008	0.48	ND	ND	0.08	ND	ND	0.2	0.19	0.23	1.4	1.9	0.074	0.14
2003006-009	ND	ND	ND	ND	ND	ND	ND	ND	0.0021	0.0078	0.015	ND	0.0019
2003006-010	1.1	ND	ND	0.27	ND	0.093	0.51	0.3	0.24	1.2	2.1	0.11	0.25
2003006-011	ND	ND	ND	ND	ND	ND	0.0052	ND	0.0033	0.013	0.018	0.0013	0.0021
2003006-012	1.1	ND	ND	0.24	ND	0.059	0.45	0.25	0.32	1.6	2.2	0.12	0.27
2003006-013	ND	ND	0.0022	0.0039	ND	ND	0.0045	ND	0.0017	0.0066	0.013	ND	0.0012
2003006-014	0.6	ND	0.031	0.24	ND	0.033	0.26	0.079	0.077	0.7	0.65	0.074	0.11
2003006-015	ND	ND	0.0022	ND	ND	ND	0.0036	ND	0.0021	0.0074	0.013	ND	ND
2003006-016	1.1	ND	ND	0.18	ND	ND	0.43	0.15	0.29	1.4	2.2	0.12	0.27
2003006-017	0.023	ND	0.0041	0.013	ND	0.0046	0.019	ND	0.0074	0.035	0.051	0.0034	0.0047
2003006-018	1.9	ND	0.058	0.65	ND	0.24	0.72	0.37	0.53	2.3	3.3	0.27	0.49
2003006-019	0.022	ND	0.0042	0.017	ND	0.0042	0.021	0.0053	0.0056	0.027	0.045	0.0026	0.0044
2003006-020	1.6	0.028	0.1	0.86	0.038	0.28	1	0.44	0.36	2	3.1	0.19	0.35

Table 2 - Sample Data for Lobsters, 2002 (ug/g wet weight)

Sample #	BZ.187	BZ.195	BZ.206	BZ.209	Sum of 16 NOAA Congeners	BZ.77	BZ.81	BZ.105	BZ.114	BZ.118	BZ.123	BZ.126	BZ.156
2003006-001	ND	ND	ND	ND	0.0290	ND	ND	ND	ND	0.0073	ND	ND	ND
2003006-002	0.13	ND	ND	ND	3.7360	ND	ND	0.24	0.023	1.3	ND	ND	0.11
2003006-003	ND	ND	ND	ND	0.0147	ND	ND	ND	ND	0.0064	ND	ND	ND
2003006-004	0.19	ND	ND	ND	4.2470	ND	ND	0.21	0.013	1.3	ND	ND	0.17
2003006-005	0.0024	ND	ND	ND	0.0318	ND	ND	0.003	0.007	ND	ND	ND	0.0016
2003006-006	0.43	0.02	0.019	ND	6.6690	ND	ND	0.38	0.048	1.9	ND	ND	0.22
2003006-007	ND	ND	ND	ND	0.0169	ND	ND	ND	ND	0.0068	ND	ND	ND
2003006-008	0.2	ND	ND	ND	4.4140	ND	ND	0.21	0.02	1.2	ND	ND	0.14
2003006-009	ND	ND	ND	ND	0.0268	ND	ND	0.0029	ND	0.0087	ND	ND	0.0013
2003006-010	0.18	ND	ND	ND	5.2530	ND	ND	0.3	0.013	1.6	ND	ND	0.16
2003006-011	ND	ND	ND	ND	0.0429	ND	ND	0.0039	ND	0.015	ND	ND	0.0012
2003006-012	0.18	ND	ND	ND	5.6890	ND	ND	0.33	0.041	2	ND	0.018	0.17
2003006-013	ND	ND	ND	ND	0.0331	ND	ND	0.0043	ND	0.011	ND	ND	0.0011
2003006-014	0.12	ND	ND	ND	2.3740	ND	ND	0.2	ND	0.44	ND	ND	0.097
2003006-015	ND	ND	ND	ND	0.0283	ND	ND	ND	ND	0.0073	ND	ND	0.0011
2003006-016	0.18	ND	ND	ND	5.2200	ND	ND	0.4	0.033	1.9	ND	ND	0.16
2003006-017	0.0048	ND	ND	ND	0.1470	ND	ND	0.013	ND	0.053	ND	ND	0.0046
2003006-018	0.37	0.016	ND	ND	9.3140	0.12	ND	0.58	0.073	3.1	ND	0.035	0.28
2003006-019	0.0048	ND	ND	ND	0.1411	ND	ND	0.013	ND	0.056	ND	ND	0.004
2003006-020	0.38	0.016	ND	ND	9.1420	0.19	ND	0.51	0.08	3.2	ND	0.034	0.25

Table 2 - Sample Data for Lobsters, 2002 (ug/g wet weight)

Sample #	BZ.157	BZ.167	BZ.169	BZ.189	Sum of 12 WHO Congeners	Solids %	Cadmium	Chromium	Copper	Lead	Weight g - wet
2003006-001	ND	ND	ND	ND	0.0073	21.9	0.045	ND	30	ND	336
2003006-002	0.039	ND	ND	ND	1.7120	33	5.62	ND	59	ND	49
2003006-003	ND	ND	ND	ND	0.0064	21.7	0.067	ND	29	ND	436
2003006-004	0.059	0.1	ND	ND	1.8520	38.2	6.6	ND	254	ND	56
2003006-005	ND	ND	ND	ND	0.0116	17.7	0.085	ND	23	ND	381
2003006-006	0.1	0.19	ND	ND	2.8380	30.5	4.8	ND	328	ND	44
2003006-007	ND	ND	ND	ND	0.0068	21.9	0.039	ND	29	ND	443
2003006-008	0.054	0.11	ND	ND	1.7340	36.1	7.52	0.126	149	ND	56
2003006-009	ND	ND	ND	ND	0.0129	19.6	0.034	0.016	29	ND	499
2003006-010	0.059	0.12	ND	ND	2.2520	34.9	7	ND	328	ND	67
2003006-011	ND	ND	ND	ND	0.0201	20.6	0.032	ND	28	ND	573
2003006-012	0.065	0.13	ND	ND	2.7540	33.4	5.4	ND	420	ND	77
2003006-013	ND	ND	ND	ND	0.0164	22	0.022	ND	34	ND	516
2003006-014	0.034	0.074	ND	ND	0.8450	30.3	5.26	ND	158	ND	82
2003006-015	ND	ND	ND	ND	0.0084	23.2	0.038	ND	31	ND	557
2003006-016	0.067	0.12	ND	ND	2.6800	37.7	5.1	ND	337	ND	80
2003006-017	0.0015	0.0029	ND	ND	0.0750	19.6	0.019	ND	25	ND	427
2003006-018	0.1	0.2	ND	0.018	4.5060	25.4	4.1	ND	505	ND	60
2003006-019	0.0013	0.0029	ND	ND	0.0772	18.2	0.024	ND	24	ND	343
2003006-020	0.075	0.2	ND	0.014	4.5530	26.4	1.56	ND	230	ND	51

Table 3 - Sample Data for Winter Flounder and American Eel, 2002 (ug/g wet weight)

SAMPLE #	Species	Closure Area	Location	Sum of 28 Congeners	Sum of 5 Aroclors	Lipids %	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254
2003006-021	Winter Flounder	I	A: W-Barrier Open	0.45	0.56	0.14	ND	0.088	ND	0.44
2003006-022	Winter Flounder	I	B: 195 Overpass	1.55	2.84	0.18	ND	0.8	ND	1.9
2003006-023	American Eel	I	A:195 Overpass	52.39	70.90	9.3	ND	5.4	ND	62
2003006-024	American Eel	I	B: W lighthouse	13.63	10.72	8.5	ND	0.24	ND	9.6
2003006-025	American Eel	I	C: SW Culvert	15.59	13.70	5.1	ND	0.78	ND	12
2003006-026	American Eel	I	D: Marina	3.66	2.16	2	ND	0.56	ND	1.3

ND = Not detected

Table 3 - Sample Data for Winter Flounder and American Eel, 2002 (ug/g wet weight)

SAMPLE #	Aroclor 1260	BZ.8	BZ.18	BZ. 28	BZ.44	BZ.52	BZ.66	BZ.101	BZ.128	BZ.138	BZ.153	BZ.170	BZ.180	BZ.187
2003006-021	0.034	0.0014	0.0061	0.034	0.0015	0.015	0.034	0.018	0.0092	0.052	0.075	0.0044	0.0077	0.0045
2003006-022	0.14	0.019	0.049	0.28	0.035	0.14	0.088	0.16	0.017	0.1	0.15	0.01	0.02	0.02
2003006-023	3.5	ND	0.3	2.3	2.2	8.4	3.2	6.5	0.75	4.4	6.1	0.4	0.66	0.72
2003006-024	0.88	ND	ND	0.38	0.27	1.5	0.73	1.7	0.25	1.5	1.1	0.098	0.22	0.17
2003006-025	0.92	ND	0.052	0.36	0.33	1.4	0.73	1.9	0.28	1.6	2.1	0.097	0.21	0.18
2003006-026	0.3	ND	0.05	0.07	0.047	0.28	0.075	0.18	0.056	0.51	0.67	0.041	0.062	0.05

Table 3 - Sample Data for Winter Flounder and American Eel, 2002 (ug/g wet weight)

SAMPLE #	BZ.195	BZ.206	BZ.209	Sum of 16 NOAA Congeners	BZ.77	BZ.81	BZ.105	BZ.114	BZ.118	BZ.123	BZ.126	BZ.156	BZ.157
2003006-021	ND	ND	ND	0.2628	0.002	ND	0.013	ND	0.07	ND	ND	0.0055	0.0014
2003006-022	0.0019	0.0015	ND	1.0914	0.009	ND	0.03	0.0047	0.16	ND	ND	0.012	0.0029
2003006-023	ND	ND	ND	35.9300	ND	ND	0.57	0.19	6.5	ND	ND	0.5	0.13
2003006-024	ND	ND	ND	7.9180	ND	ND	0.45	ND	2.1	ND	ND	0.15	0.047
2003006-025	ND	ND	ND	9.2390	ND	ND	0.57	ND	2.3	ND	ND	0.15	0.045
2003006-026	ND	ND	ND	2.0910	0.018	ND	0.11	ND	0.56	ND	ND	0.05	0.014

Table 3 - Sample Data for Winter Flounder and American Eel, 2002 (ug/g wet weight)

SAMPLE #	BZ.167	BZ.169	BZ.189	Sum of 14 WHO Congeners	Abnor-malities	Cadmium	Chromium	Copper	Lead	Length cm	Sex	Solids %	Weight g - wet
2003006-021	0.0035	ND	ND	0.0956	None	ND	0.068	3.1	ND	29	Female	21.4	282
2003006-022	0.009	ND	ND	0.2272	None	ND	0.08	1.56	ND	27	Female	20.7	213
2003006-023	0.34	ND	ND	8.2300	None	ND	ND	0.12	ND	73	Unknown	30.8	830
2003006-024	0.11	ND	ND	2.8570	None	ND	0.066	1	ND	73	Unknown	20.9	764
2003006-025	0.11	ND	ND	3.1750	None	ND	ND	0.14	ND	43	Unknown	25.4	117
2003006-026	0.031	ND	ND	0.7830	None	ND	0.032	0.61	ND	57	Unknown	25.7	314

Table 4 - Metals in New Bedford Harbor Seafood, 2002 - ppm wet wt.

	Closure Area	Tomalley?	sample 1	sample 2	sample 3	sample 4	sample 5	Average	Standard Deviation
COPPER									
Flounder	I		3.100	1.560				2.330	1.089
Eel	I		0.120	1.000	0.140	0.610		0.468	0.502
Lobster	II	tail & claw	28.000	34.000	31.000	25.000	24.000	28.400	4.159
	II	tomalley only	420.000	158.000	337.000	505.000	230.000	330.000	139.962
	II	combined	74.000	51.000	69.000	84.000	51.000	65.800	14.550
	III	tail & claw	30.000	29.000	23.000	29.000	29.000	28.000	2.828
	III	tomalley only	59.000	254.000	328.000	149.000	328.000	223.600	117.666
	III	combined	34.000	55.000	55.000	42.000	64.000	50.000	11.895
Quahog	I		2.950	2.860	7.100	3.680	4.080	4.134	1.734
	II		1.750	0.734	2.330	1.670	2.160	1.729	0.621
	III		2.370	1.970	1.700	1.200	1.750	1.798	0.426
CHROMIUM									
Flounder	I		0.068	0.080				0.074	0.008
Eel	I		nd	0.066	nd	0.032		0.049	0.024
Lobster	II	tail & claw	nd	nd	nd	nd	nd	na	na
	II	tomalley only	nd	nd	nd	nd	nd	na	na
	II	combined	na	na	na	na	na	na	na
	III	tail &claw	nd	nd	nd	nd	0.016	na	na
	III	tomalley only	nd	nd	nd	0.126	nd	na	na
	III	combined	na	na	na	na	na	na	na
Quahog	I		0.277	0.315	0.617	0.458	0.633	0.460	0.165
	II		0.350	0.169	0.339	0.293	0.296	0.289	0.072
	III		0.257	0.102	0.097	0.061	0.383	0.180	0.136

Table 4 - Metals in New Bedford Harbor Seafood, 2002 - ppm wet wt.

	Closure Area	Tomalley?	sample 1	sample 2	sample 3	sample 4	sample 5	Average	Standard Deviation
CADMIUM									
Flounder	I		nd	nd				na	na
Eel	I		nd	nd	nd	nd		na	na
Lobster	II	tail & claw	0.032	0.022	0.038	0.019	0.024	0.027	0.008
	II	tomalley only	5.400	5.260	5.100	4.100	1.560	4.284	1.606
	II	combined	0.668	0.740	0.674	0.522	0.223	0.565	0.207
	III	tail & claw	0.045	0.067	0.085	0.039	0.034	0.054	0.021
	III	tomalley only	5.620	6.600	4.800	7.520	7.000	6.308	1.093
	III	combined	0.755	0.811	0.573	0.879	0.859	0.775	0.123
Quahog	I		0.066	0.084	0.098	0.071	0.112	0.086	0.019
	II		0.064	0.033	0.141	0.065	0.052	0.071	0.041
	III		0.054	0.084	0.063	0.083	0.109	0.079	0.021
LEAD									
Flounder	I		nd	nd				na	na
Eel	I		nd	nd	nd	nd		na	na
Lobster	II	tail & claw	nd	nd	nd	nd	nd	na	na
	II	tomalley only	nd	nd	nd	nd	nd	na	na
	II	combined	na	na	na	na	na	na	na
	III	tail & claw	nd	nd	nd	nd	nd	na	na
	III	tomalley only	nd	nd	nd	nd	nd	na	na
	III	combined	na	na	na	na	na	na	na
Quahog	I		1.020	0.972	1.800	1.370	1.370	1.306	0.334
	II		0.389	0.086	0.189	0.201	0.462	0.265	0.155
	III		0.830	0.377	0.075	0.096	0.300	0.336	0.305

nd = non-detect na = not applicable

Table 5 - Calculation of PCBs in tomalley, tail and claw meat, Area II

sample #	ppm meat	wt meat	product	ppm tomalley	wt tomalley	product	total wt	sum of products	(sum of products divided by total wt.) total conc.
Aroclor method									
006-011/12	0.01	573	5.73	1.79	77	137.83	650	143.56	0.22
006-013/14	0.05	516	25.8	1.72	82	141.04	598	166.84	0.28
006-015/16	0.062	557	34.534	1.92	80	153.6	637	188.134	0.3
006-017/18	0.163	427	69.601	5	60	300	487	369.601	0.76
006-019/20	0.083	343	28.469	8.2	51	418.2	394	446.669	1.13
								avg	0.538
Congener method									
006-011/12	0.063	573	36.099	8.443	77	650.111	650	686.21	1.06
006-013/14	0.0494	516	25.4904	3.219	82	263.958	598	289.4484	0.48
006-015/16	0.0367	557	20.4419	7.9	80	632	637	652.4419	1.02
006-017/18	0.222	427	94.794	13.82	60	829.2	487	923.994	1.9
006-019/20	0.2183	343	74.8769	13.695	51	698.445	394	773.3219	1.96
								avg	1.284

Table 6 - Calculation of tomalley, tail and claw meat, Area III

Aroclor method Sample #	ppm meat	wt meat	product	ppm tomalley	wt. tomalley	product	total wt	sum of products	(sum of products divided by total wt.) total conc.
006-001/2	0.01	336	3.36	1.56	49	76.44	385	79.8	0.2072727
006-003/4	0.01	436	4.36	2.17	56	121.52	492	125.88	0.2558537
006-005/6	0.01	381	3.81	2.95	44	129.8	425	133.61	0.3143765
006-007/8	0.01	443	4.43	0.48	56	26.88	499	31.31	0.0627455
006-009/10	0.01	499	4.99	1.47	67	98.49	566	103.48	0.1828269
								avg	0.204615
congener method									
006-001/2	0.04	336	13.44	5.448	49	266.952	385	280.392	0.7282909
006-003/4	0.02	436	8.72	6.099	56	341.544	492	350.264	0.7119187
006-005/6	0.04	381	15.24	9.507	44	418.308	425	433.548	1.0201129
006-007/8	0.02	443	8.86	6.148	56	344.288	499	353.148	0.7077114
006-009/10	0.04	499	19.96	7.505	67	502.835	566	522.795	0.9236661
								avg	0.81834

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